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PART II

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LIST OF EXPERIMENT STATIONS AND STAFF LIST

The experiment stations in operation during the period under review and the officers who have been in residence are listed below:—

Agricultural Research Station, Lilongwe

Chief Agricultural Research Officer	S. T. Hoyle
Agricultural Officer (Tobacco)	J. F. Conroy
Agricultural Officer (Agronomist)	J. McIlroy
Plant Breeder	R. T. Ellis
Chemist (from May, 1954)	R. A. Wood
Senior Agricultural Instructor	W. D. Chona
Senior Agricultural Instructor	Y. J. Kamponda
Field Officer (until July, 1954)	R. E. Jackson
Field Officer (from July)	G. L. Bailey

Tea Experiment Station

Tea Research Officer	D. L. Downie
Agricultural Officer	D. H. Laycock
Field Officer	G. A. Bridger

Bvumbwe Tung and Experiment Station

Agricultural Officer	L. J. Foster
Agricultural Chemist	C. V. Cutting
Field Officer (until February, 1954)	W. F. Irvine
Field Officer (from February)	K. Wicketts
Field Officer	C. J. Trigwell

Tuchila Experiment Station

Officer in Charge	G. S. Barker

Makanga Experiment Station

Officer in Charge	J. W. Killick

Mwera Hill Experiment Station

Agricultural Officer	J. Evans

Lisasadzi Experiment Station

Officer in Charge	R. F. Cumpston

Mbawa Experiment Station

Officer in Charge (until March, 1954)	F. Higson
Officer in Charge (from March)	C. B. Roberts

Provincial Agricultural Officers

Southern Province	(until March, 1954)	M. F. H. Selby
	(from March)	J. A. Sandys
Central Province	(until May, 1954)	H. W. T. Webb
	(from May)	A. B. Cormack
Northern Province		R. Smith

Headquarters

Entomologist	E. L. Drake
Entomologist (Research)	Dr. K. F. Salmond

MAIZE

Breeding Work

Some 700 lines were self-pollinated. Of these some are now in their sixth, some fifth, and some fourth year of inbreeding, whilst others, which had been collected from villages in the Central Province, were selfed for the first time. Some of the S5 and S4 lines are beginning to show a satisfactory uniformity within themselves.

Based on the results of the 1952/53 season Top Cross yield trial the most promising Inbreds (S5 and S4) were used in the following way:—

(1) Sixteen Inbred Lines were combined together to form Synthetic Variety No. 1.

(2) Fifteen Top Crosses (local Inbred Lines X Namalenga) were combined together to form Synthetic Variety No. 2.

(3) Two selected Top Crosses (Local Inbred Lines X Namalenga) were crossed together reciprocally to form a Double Top Cross. On Isolation Plots these Top Crosses were made again on a large scale so that the Double Top Cross can be made on a commercial scale in 1954/55 and sold as such if successful in trial.

(4) Twenty Inbred Lines were crossed with one another in every possible combination, to give 190 Single Cross Hybrids.

Forty-six Top Crosses made in 1952/53 season were tested in a yield trial. In all cases Namalenga was the pollen parent. Local Inbreds were the female parents in 44 cases, and Southern Rhodesian Inbreds in the other two. Growth and yields of grain were again very satisfactory. One of the Top Crosses, with a Southern Rhodesian Inbred, gave the highest yield but this was not significantly greater than three of those with Local Inbreds and suffered from the defect of bad keeping quality of the grain. Some selected yields from this trial are given at Table I below.

There was a good correlation between the performance of the various families of Inbreds in this trial and in the Top Cross trial of 1952/3. One family, Likuni 18, was represented in the first and fourth Top Crosses in order of yield in 1952/3 trial and the second and third in 1953/4.

Table I: Top Crosses Yield Trial 1953/54

Yield of grain lbs./acre

46 *Top Crosses*
3 *Controls*

Order of yield	
1st	A3–1–49 (S.R. Inbred) × Namalenga=5,751
2nd	L2,255 × Namalenga=5,587
19th	K4–2–2–2 (S.R. Inbred) × Namalenga=4,513
21st	Namalenga O.P. (Control) =4,513
36th	Local O.P. (Control) =3,674
49th	R2,369 × Namalenga=3,014
	Mean=4,437
	L.S.D.= 495

More Top Crosses of Local Inbred Lines, with Namalenga as pollen parent, were made in an Isolation Block. Inbred Lines from Southern Rhodesia, South Africa and Georgia, which had been selfed or sibbed here in 1952/53, grew so badly that they could not be maintained. A collection of basic maize types from the West Indies grew very well.

A quick method of maize improvement by the selection of superior genotypes from a bulk as suggested by Harland was applied to some locally collected maize.

In a special trial a number of F1 Top Crosses out-yielded their once grown seed (F2) by 25.18 per cent.

Diseases

Work was confined to the study of the rusts *Puccinia sorghi* and *Puccinia polysora*. Over 700 ten yard rows of different varieties and strains, many of them supplied from South and East Africa, were grown in order to score for differences in susceptibility to the rusts. A replicated trial was grown with three varieties of maize in which half the plots were sprayed with a fungicide (BLITANE) in order to reduce the incidence of rust, so that by comparison with the infected unsprayed plots an estimate of loss in yield due to the disease could be obtained.

Puccinia sorghi was widespread from early January but as usual appeared to be well tolerated by the maize. *Puccinia polysora* was first observed at the Nyasaland Food Corporation's Rivi Rivi Farm, Balaka, on 13th February but did not appear at the Agricultural Research Station, Lilongwe, until 9th March; its spread then on susceptible plants was rapid. The disease did not appear on plants until flowering was well advanced and in most cases the grain was already set. Scores were made on the same day (*see* table below) of the incidence of rust on two comparable plots of Southern Rhodesia Hybrid VII, one planted nine days later than the other. It will be seen that the scores are lower on the later planted maize. These scores illustrate what was a common observation on all maize planted on the station both in this season and for 1952/53. The results for these two seasons suggest therefore that under local conditions *Puccinia polysora* may not be expected to attack maize until it has already started to mature its grain and will not therefore cause the devastation to the crop that has been reported from West Africa where young plants were attacked and no grain harvested.

Table II: Scores for Puccinia Polysora on S.R. Hybrid VII

	Planted 1–12–53	Planted 9–12–53
Average score per plant	3.5	2.0
Number of plants per row of 60 with score of 5 and over	24.7	12.5
Number of plants per row of 60 with score of 9	9.3	2.0

Method of Scoring:

	Mild	*Moderate*	*Severe*
Top leaves	1 ..	2 ..	3
Middle leaves	1 ..	2 ..	3
Bottom leaves	1 ..	2 ..	3
	Total Possible ..		9

There were also clearcut differences in varietal susceptibility and these were not correlated with susceptibility to *Puccinia sorghi*. The only really susceptible varieties were the Southern Rhodesian Hybrids; all local strains had a good degree of resistance.

Table III: Average Score per Plant for Incidence of Puccinia Polysora

Date	Namalenga		S.R. Hybrid VII		Local Bulk	
	Unsprayed	*Sprayed*	*Unsprayed*	*Sprayed*	*Unsprayed*	*Sprayed*
14–4–54	1.9	0.7	3.5	1.9	1.6	0.5

The spraying trial was successfully carried out. The Southern Rhodesian Hybrid was the only variety to suffer loss in yield despite the fact that in all three varieties there were big differences in the incidence of the disease on the sprayed and unsprayed plots. (*See* Table below.)

TABLE IV: EFFECT OF SPRAYING ON MAIZE YIELDS, LBS. GRAIN PER ACRE

	Namalenga	*S. Rhodesian Hybrid VII*	*Local Bulk*	
Sprayed	6675.25	9179.44	4673.68	6846.12
Unsprayed	6681.98	7641.32	4982.15	6435.15
	6678.63	8400.38	4827.94	

L.S.D. = 904.04 lbs./acre for centre of table.
638.65 lbs./acre for marginal totals.

The above observations agree with those made in the 1952/53 season and suggest that due to the resistance of the local varieties and the late appearance in the season of the disease, *Puccinia polysora* may not be the severe menace to maize-growing in this part of Africa that was at one time feared.

VARIETY

Replicated trials conducted at Chitedze and Tuchila confirmed the Southern Rhodesian hybrids as being higher yielding than locally selected types, yields averaging 25 bags per acre at Chitedze and 14 bags per acre at Tuchila. Namalenga averaged 20 and 11 bags per acre respectively and was the best of the locally selected types. Ordinary unselected village maize averaged only 14 and 11 bags per acre respectively.

One feature of the trials was the difference in yield of seed from tips, butts and middles of cobs.

TABLE V: YIELDS OF MAIZE FROM VARIOUS PARTS OF COB

	Agricultural Research Station	*Tuchila*
Namalenga Tips	3,300	2,202
Butts	4,388	2,272
Middles	4,281	2,136
Rivi Rivi Hybrid Tips ..	5,613	2,490
Butts ..	5,306	2,798
Middles ..	5,785	2,861
L.S.D.	635	243

The picture will be further clarified in subsequent work by a more critical assessment of the fractions of the cob responsible for these differences. In no case, however, was " butt " seed significantly inferior to seed from the middle of the cob.

Namalenga is of course preferable to Southern Rhodesian hybrids, because of the fact that it can be more easily pounded into meal by the African and has superior qualities.

Fertilizer Trials

Dung. Three trials were carried out this year to determine the effect of 5 tons/acre FYM and *khola* (kraal) manure. The results are shown below:

Table VI: Effect of Dung on Yields of Maize

(*Lbs./acre grain*)

	Agricultural Research Station	*Tuchila*	*Mbawa*
No dug	3,695	2,081	2,148
5 tons/acre F.Y.M.	3,273	2,782	2,813
5 tons/acre *khola* manure ..	3,550	2,684	2,550
L.S.D.	328	133	254

The results show the expected increase in yield at Tuchila and Mbawa. The decrease in yield at Chitedze may be due to the application of material with a high C/N ratio which would immobilize some available soil nitrogen. It is intended that future work should go hand in hand with analysis of the material applied.

Nitrogen. Results obtained from eight station trials and three sets of trials in Native Agricultural Instructors' gardens show that in every case but one a significant response was obtained and that the percentage increase due to any one rate of application was inversely associated with the unfertilized yield.

Table VII: Response of Maize to Nitrogen

(*Lbs./acre grain*)

75 lbs./acre S/A			150 lbs./acre S/A			300 lbs./acre S/A		
Unfertilized yield	*Increase*	*Per cent.*	*Unfertilized yield*	*Increase*	*Per cent.*	*Unfertilized yield*	*Increase*	*Per cent.*
939	615*	65	551	848*	154	551	1,333*	242
1,097	865*	79	1,354	894*	66	1,354	1,532*	113
1,932	564*	29	1,522	883*	58	1,522	847*	56
1,958	602*	31	1,932	1,189*	62	2,623	598*	23
2,197	434*	20	1,958	1,034*	53	—	—	—
3,248	358*	11	2,623	409*	16	—	—	—
4,696	317*	7	3,248	444*	14	—	—	—
—	—	—	4,696	448*	10	—	—	—

*Denotes significance

Phosphate: Response to phosphate continued to show variation. Of 21 trials in Native Agricultural Instructors' gardens only four significant positive responses were obtained and in each case, the unfertilized yields were less than 1,000 lbs. per acre grain. 200 lbs./acre superphosphate significantly depressed the yield at Tuchila, when applied as a narrow band below the ridge. At the Agricultural Research Station one experiment gave a significant positive response to 100 lbs. and 200 lbs./acre superphosphate, while a neighbouring experiment gave virtually no response whatever.

Potash: There were no significant responses to direct application, though at the Tung Station there was a significant positive residual effect to 300 lbs./acre sulphate of potash applied the previous year. There were no other residual effects in either of the two experiments at the Agricultural Research Station and the Tung Station.

Cultural Treatments

Time of Planting

Five experiments were laid down to determine the optimum time of planting for maize and, while the trial at Makanga was of doubtful value, due to drought, results at the other four centres are in full agreement.

Table VIII: Effect of Time of Planting on Maize
(*Lbs./acre grain*)

	Agricultural Research Station	*Tuchila*	*Mbawa*	*Chitala*
Beginning of December	4,492	2,741	1,990	2,658
Middle of December	2,761	2,055	1,461	2,400
End of December	1,623	1,692	383	1,239
L.S.D.	468	238	291	277

The results confirm the great advantage of early planting. It was also found that the response to sulphate of ammonia both at 150 and 300 lbs./acre progressively increased with earlier planting. This gives little support to the idea that the success of early planting is due to accumulations of available soil nitrogen subsequently leached. Also, at the Agricultural Research Station soil temperatures, to a depth of 12 ins. were found to be appreciably lower at the first time of planting than with later plantings and the causes for the phenomenon are still not clear.

Time of Cultivation

An experiment on the effect of delayed weeding at Makanga showed that this was very considerable.

Table IX: Effect of Various Times of First Weeding
(*Lbs./acre grain*)

	Weeding at optimum time	*Weeding delayed for 10 days*	*Weeding delayed for 20 days*
No Nitrogen	1,043	732	595
150 lbs./acre S/A	1,094	811	488
Mean	1,068	772	542

L.S.D. means 139 L.S.D. Interaction Times × Nitrogen = 196

Type of Cultivation

An experiment at Mbawa to study the effects of scraping up the old ridge, splitting the ridges, and digging between the ridges and then splitting, showed that while there was a significant advantage in splitting the ridges, there was no additional advantage in digging between the ridges.

An experiment carried out at Makanga, where conditions were very poor generally (rainfall Dec.–April inclusive being only 13.34 ins.), showed a very great advantage in all measures calculated to conserve moisture.

Table X: Effect of Various Cultural Treatments
(*Lbs./acre grain*)

	No mulch	*Light mulch*	*Heavy mulch*
Planted on flat	613	2,768	3,510
Land ridged	2,413	3,785	3,721
Land ridged and boxed	3,163	4,293	5,762
L.S.D. between treatments		219	

It seems likely that where rainfall is marginal for maize far larger increases can be obtained with cultural treatments of this kind than with fertilizers for, while not strictly comparable, the yields obtained in this experiment were vastly greater than those obtained in experiments on the same station in which 150 lbs. sulphate of ammonia was applied.

Chemical Weed Control

An experiment at Agricultural Research Station confirmed that Fernoxone and Fernamine, the sodium salt and amine of 2–4–D respectively, applied as a pre-emergence spray controlled weeds to some extent but that this had little effect on the yield of maize.

SORGHUM

Work on this crop was again confined to single plot observation of some 50 varieties. The varieties giving the highest yield at various stations were as follows:—

TABLE XI: PROMISING SORGHUM VARIETIES 1953/54

Station	*Tuchila*	*Mbawa*	*Makanga*
Varieties	T/S 11 T U/S 13 T T/S 31 M T/S 26 DC U/S 2 TC U/S 8 T	S/S 25 DC U/S 16 MC S/S 46 DC T/S 28 MC Feterita 6 DC Pop DO D Feterita 623–807–18 DC L 20 MO S/S 28 MC 4/7 TC	T/S 23 S/S 10 DC T/S 19 DC S/S 40* DC S/S 25 DC

* Showed signs of covered smut at Makanga, severely damaged by birds at Mbawa.
T=Tall M=Medium D=Dwarf C=Club O=Open.

ELEUSINE

A replicated experiment with 0, 100, 200 lbs. sulphate of ammonia, superphosphate and muriate of potash was carried out at Mbawa this year. The stand was poor but some of the results proved on analysis to be significant.

TABLE XII: RESPONSE OF ELEUSINE TO FERTILIZER

(*Weight dry heads per acre*)

Fertilizer	*Nitrogen*	*Phosphate*	*Potash*
0 lbs./acre	1,117	1,142	1,215
100 lbs./acre	1,284	1,233	1,266
200 lbs./acre	1,458	1,372	1,265
	L.S.D.=170		

The coefficient of variation was fairly high at 20 per cent. and the results are not completely reliable. They do, however, confirm previous years' results in showing a response to sulphate of ammonia, although the previous response to potash was not observed, and there was this year a significant response to 200 lbs./acre superphosphate.

CEREALS

Wheat: Various high altitude Kenya wheats were tried out at North Vipya and at Neno. Growth was not successful at either station, yields being less than 550 lbs./acre in all cases.

An irrigated fertilizer trial at Sombani with 100 lbs./acre sulphate of ammonia, 200 lbs./acre superphosphate, 25 lbs./acre muriate of potash and four sowing dates ranging from 1st May to 13th June gave no significant results. The mean yield per acre was 567 lbs./acre grain.

A fertilizer trial at Neno showed no response to 200 lbs. sulphate of ammonia but the coefficient of variation was very high and very little reliance can be placed on the results. There was some indication of a response to 100 lbs./acre superphosphate.

Various varieties of Kenya summer wheat were tried at Mwera Hill with the following results:

TABLE XIII: TIME OF SOWING IN RELATION TO WHEAT YIELDS

(*lbs./acre grain*)

Variety	184	294	318	337	360
Sown 16–12–53	500	812	625	1,083	708
„ 15– 1–54	729	416	708	Nil	Nil
„ 15– 2–54	Nil	Nil	Nil	Nil	Nil

It was noted that as in the previous year the earlier sowings had on the whole produced the highest yields. The most reliable varieties from two years' results would appear to be 184, 294 and 318. Cutting back the plants at 8 ins. high, in an attempt to improve tillering, had an overall adverse effect where it was carried out.

Of five varieties tried at Nchenachena, Kenya Settler I was the only one to give a worthwhile yield at 871 lbs./acre grain. The variety 337 gave only 436 lbs./acre.

At Bvumbwe, fertilized yields of several varieties tried failed to rise above 670 lbs./acre. The previous years, yields of the same varieties averaged less than 100 lbs./acre.

Barley: All varieties tried at North Vipya (including Spratt Archer) gave less than 300 lbs./acre grain.

Oats and Rye: Oats were a complete failure at North Vipya, due to heavy attacks of rust, and the local variety of rye gave less than 250 lbs./acre grain. Rye was also a failure at Mwera Hill.

Rice: Simple variety trials were carried out at Chilwa, with the following results:

TABLE XVI: RICE VARIETIES, 1953/54

(*lbs./acre paddy*)

0/602 *ex* Shindano	6,340
Creole *ex* Demarara	5,469
0/906 *ex* Afaa Kilomhero	4,448
Kahogo	4,231
Demarara	4,114
Faya *ex* Kota Kota	3,916
Faya *ex* Sombani	3,872
Burma	3,146
Maji Maji	3,122
Faya *ex* Karonga	2,628
Swaziland	1,366

Irrigation applied was equivalent to 4 Acre feet.

A fertilizer trial on Faya ex Kota Kota with 100 lbs./acre sulphate of ammonia, 200 lbs./acre superphosphate and 25 lbs./acre muriate of potash produced no significant results.

A trial designed to study the effect of nitrogen and puddling of the soil produced no significant results.

Time of planting trial indicated that early November was the best time of planting at Chilwa and rates of seeding up to 140 lbs./acre were tried. The results are shown below.

TABLE XV: EFFECT OF TIME OF SOWING AND SEED RATE

(*lbs./acre paddy*)

Seed Rate	80 *lbs./acre*	100 *lbs./acre*	120 *lbs./acre*	140 *lbs./acre*
November	1,593	1,565	1,387	2,293
December	1,646	2,327	2,521	2,702
January	1,145	1,218	1,109	1,173

The figures show that December plantings gave the highest yield but it was noted that the November plantings were badly affected by weeds and it was thought that with this factor brought under control the early plantings would be superior.

Variety observations at Fort Manning at various centres showed that the early maturing varieties Burma and Maji Maji were more suited to the dry conditions than Demarara, Faya, Kahogo and local Faya. Later maturing Burma and Maji Maji would also appear to yield well under the moister conditions at Kota Kota, though there the variety Faya is thought to be preferable.

It was noted that careful bunding at Banga (Nkata Bay) using 6 ins. vertical intervals allowed weeds to be controlled fairly successfully. This has been shown to be extremely important in other parts of the world.

OIL SEEDS

GROUNDNUTS

Varieties: In five varietal trials planted this year, bunch types were superior at Chitedze, Tuchila and Chitala, while runner types gave highest yield at Mbawa. Since variation with season and between Station continues to be observed, it seems reasonable to conclude that neither bunch nor runner types are necessarily superior in yield but that their relative performance depends on the weather at their respective times of maturity.

Within each group, moreover, no one variety has proved outstanding, though among bunch varieties U/A 11, Masambika, Natal Common and Barberton have been more consistently high yielding than others so far tried. These nuts are all of similar type, with the exception of Masambika, which has a larger nut.

Amoung runner types U/A 29 and SA/A 6 have been consistently high yielding, as have U/A 28 and U/A 1, though the latter have unfavourable cooking qualities. Mwitunde has done relatively well, though as an export groundnut it has a low oil content. It has the advantage of being a semi-bunch type, relatively easy to harvest. Another variety possessing this characteristic is SA/A 5, though this has only been tested for one year. Chimbuwila, the popular local runner, while not normally reaching the yields achieved by the above, yielded well under adverse conditions at Mbawa this year and had an average yield over five stations of 1,000 lbs. kernels per acre.

Fertilizers

There was no response to 200 lbs. per acre superhosphate at any of three trials at Chitedze, Tuchila, Mbawa. This is contrary to expectation but bears out the results of previous years' work.

Spacing

Three trials, comparing three rows per ridge with two rows per ridge at 12 ins. spacing in the row, showed that in every case there was a significant increase in yield with three rows. The increase averaged 120 lbs. per acre kernels over the three stations.

Date of Planting

The results of an experiment at Chitedze to determine the optimum date of planting and lifting of Spanish Bunch and Mwitunde are shown below.

TABLE XVI: EFFECT OF VARIOUS TIMES OF PLANTING

(*lbs./acre kernels*)

	Spanish	*Mwitunde*
Late November	1,398	1,561
Mid-December	901	696
Late December	784	811
L.S.D.	196	154

It will be seen that the date of planting is at least as critical here as it is with maize and that a delay of three weeks very appreciably decreases yields. It has been thought that bunch varieties could be planted later, due to the fact that their growing season is shorter, but the figures give no support to this.

The yields obtained by leaving the nuts in the ground for varying periods are shown below:

TABLE XVII: YIELD IN RELATION TO MATURITY

(*lbs./acre kernels*)

Spanish Bunch		*Mwitunde*	
Left for 90 days	1,138	Left for 120 days	910
„ „ 100 „	1,038	„ „ 130 „	1,028
„ „ 110 „	1,039	„ „ 140 „	1,088
„ „ 120 „	898	„ „ 150 „	1,065
L.S.D.=	172	L.S.D.=	122

The results confirm the common observation that Spanish Bunch falls off very quickly from the peak yield obtained at maturity and that the time of harvesting of Mwitunde is not so crucial.

DISEASE

An experiment was carried out at Chitedze to determine the effect of spraying Gambia and Mwitunde with Perenox and Fernide at a rate of 6 lbs./acre in 100 gallons water. The results are shown below.

TABLE XVIII: EFFECT OF CONTROLLING CERCOSPORA LEAF SPOT

(*lbs./acre kernels*)

	No Spray	*Perenox*	*Fernide*
Gambia ..	1,065 ..	1,798 ..	1,143
Mwitunde ..	913 ..	1,012 ..	898
	L.S.D.=	204	

Perenox was effective in the first six weeks of growth in greatly reducing the incidence of leaf spot on both varieties, though its relative effect over Fernide and no spray gradually decreased towards harvesting. It was noted that the buildup of the disease in Mwitunde was much slower than in Gambia and it would appear that the beneficial effect of Perenox with Gambia is due to its control of the disease in the early stages of growth. The results with Perenox on Gambia confirm those from previous work.

Castor Seed

Varieties planted at Chitedze continued to suffer from inflorescence blight and yields were very low, the highest yielding variety giving less than 400 lbs. threshed seed per acre. It was noticed, however, that the smaller varieties did better than the larger types. Three varieties grown at Chinteche in the Northern Province also gave very poor yields, and at Bvumbwe an annual variety succumbed to inflorescence blight. It would appear that unless this disease can be controlled economically there is little future for the crop in the Protectorate.

Sunflowers

Seven varieties were planted at Chitedze and six at Tuchila. Of these, three were back in each case. The yields are shown below.

Table XIX: Sunflower Varieties 1953/54

(*lbs./acre seed*)

Chitedze		*Tuchila*	
*Kampala	2,178	White Russian	1,346
Kampala White	1,839	*Kampala	1,075
Giant White	1,791	Kampala White	1,064
Giant Black	1,694	Mars	857
Black Mars	1,428	Giant Black	847
Mars	1,282	Black Mars	532
White Russian	629		

* *Not a true white but stripped grey and black.*

Of these varieties Kampala and Kampala White have yielded consistently well at Chitedze over the past two years and have also done well at Tuchila. White Russian has also yielded well at Tuchila over the past two years though it would appear to be unsuited for Chitedze. Giant Black would appear to be the most consistent of the three black seeded types.

Soya Beans

In an observation of 38 varieties at Chitedze, Hernon 279, Yellow Kedele, Glycine 317, Hernon 36 and R.184, all yielded over 600 lbs./acre threshed seed, Heron 279 being well ahead of the others, however, with 944 lbs./acre threshed seed.

At Bvumbwe, of six varieties tried Peruvian Yellow yielded 1,422 lbs./acre. Benares 1,159 lbs./acre, Malaya 1,045 lbs./acre and MIS.28, EB.818 lbs./acre.

A formal trial with nine varieties and four times of planting confirmed that early planting is very significantly superior to delayed plantings.

Table XX: Time of Planting in Relation to Some Soya Varieties

(*lbs./acre seed*)

Time of Planting	*Glycine* 29	*Pelican*	*Avoyelles*	*Light speckled*	*Volstate*
Mid-December	1,210	1,193	1,236	1,227	605
End December	743	838	890	717	406
Early January	493	424	251	424	424
Mid-January	320	294	363	363	285

L.S.D. 248

The results demonstrate yet again the beneficial effects of early planting.

Sesame

Sixteen varieties were again planted at Chitedze but all proved a complete failure. The crop was a failure at Bvumbwe also.

PULSES

Beans

Of 15 varieties tried at Chitedze only Kayera and White Haricot yielded at all well. Stands were at best only fair over the other varieties. It was also noted that in a simple unreplicated trial these two varieties, especially White Haricot, did better when broadcast on the furrow between low ridges covered by splitting the ridges.

At Bvumbwe, however, White Haricot and White Kayera yielded very poorly and the only worthwhile yield was given by White Wonder.

Tepary

In single plot observations at Chitedze, tepary planted in the second week of December yielded 513 lbs./acre seed and 467 lbs./acre planted the first week in January.

Miscellaneous

Of 19 varieties of cowpeas tried at Chitedze, Mwazisi yielded 860 lbs./acre threshed seed and Blantyre and Nseura yielded over 600 lbs./acre. The variety Turiana, planted on the 10th December, yielded 956 lbs./acre and planted on 8th January only 63 lbs./acre.

Lima beans, pigeon peas and chickpeas all failed to produce a worthwhile yield at Chitedze.

SWEET POTATOES

Eight varieties were planted at Chitedze and of these six yielded over 3,000 lbs./acre tubers, Mkokobwato and Malamulo giving over 5,000 lbs. per acre. Of the latter Mkokobwato has a yellowish-white tuber with a buff skin and Malamulo has a soft white tuber with a red skin.

GRASSLAND

Selections

Work continued at Chitedze on the selection of suitable species and varieties. Rhodes grass has been established on 35 acres as a pasture grass, while Star grass has been successful in paddocks, where its high resistance to wear and hard grazing make it useful in maintaining a cover on such areas. Certain varieties of *Panicum makarikari*, *Cenchrus ciliaris* (African foxtail) *Paspalum notatum* and Bermuda grass have been promising in the nurseries at Chitedze and are being established on a slightly larger scale for observations on comparative yield and palatability.

Fertilizers

Two experiments were carried out at the Tung Station to compare the effects of nitrogenous fertilizer at different rates and different methods of application. All rates were applied in three equal parts at three monthly intervals. In addition the heaviest rate of application was applied in nine equal parts at monthly intervals. The results are shown below:

TABLE XXI: RESPONSE TO NITROGENOUS FERTILIZER
('00 *lbs.*)
Yields as air dried grass in short tons per acre and cost of fertilizer per acre

Sulphate of Ammonia		*Rhodes grass (Teso)*		*Star grass (No. 2)*	
		yield	*cost*	*yield*	*cost*
300 lbs. every 3 months	(£19.29)	8.78	(£3.13)	12.96	(£1.94)
100 lbs. every month	(£19.29)	7.62	(£3.87)	10.52	(£2.53)
200 lbs. every 3 months	(£12.86)	7.08	(£2.88)	10.45	(£1.72)
100 lbs. every 3 months	(£ 6.43)	5.99	(£1.91)	8.24	(£1.23)
Nitramoncal					
300 lbs. every 3 months	(£15.77)	5.94	(£4.76)	7.35	(£3.65)
200 lbs. every 3 months	(£10.52)	5.21	(£4.06)	6.32	(£3.20)
100 lbs. every 3 months	(£ 5.26)	4.55	(£2.73)	5.81	(£1.88)
100 lbs. every month	(£15.77)	5.05	(£6.49)	5.62	(£6.07)
Control—no fertilizer	—	2.64 tons		3.02 tons	
Significant Differences					
P=0.05	—	0.95 tons		2.45 tons	
P=0.01	—	1.29 tons		3.34 tons	

The cost of fertilizer per each additional ton of hay is given in brackets against each yield figure (based on a price of £32–3s for sulphate of ammonia and £26–5s–9d for nitranoncal).

The first application of fertilizers was made at the end of July and the first cut taken at the end of August, the experiment covering the period 1st August, 1953, to 31st July, 1954. By the middle of October (a week after 1½ ins. rain had fallen) the Star grass plots which had received sulphate of ammonia stood out as much greener and more vigorous. There was no noticeable difference, however, on the Rhodes grass. The rainfall for the total season was only 31.07 ins. (ten year average 50.63 ins.) and by the end of May growth of the Rhodes grass was so poor that no cut could be made for two months.

It will be seen that weight for weight, sulphate of ammonia is superior to nitromoncal for this purpose, and that the limit of useful application is reached much sooner with nitromoncal; 300 lbs./acre sulphate of ammonia has more than doubled the yield of Rhodes grass and about trebled the yield of Star grass.

The results of a similar trial at Chitedze are shown below:

TABLE XXII: RESPONSE OF RHODES GRASS TO SULPHATE OF AMMONIA

	'00 *lbs.*
Control	203.98
200 lbs./acre sulphate of ammonia	244.66
400 „ „ „	245.52
600 „ „ „	318.46
800 „ „ „	296.50
1,000 „ „ „	312.55
1,200 „ „ „	312.62
1,200 „ nitromoncal	284.83
L.S.D.	90.88

At this much higher level of fertility, the response curve is rather different and an application of 600 lbs./acre sulphate of ammonia was required to produce a significant increase in yield. Ten tons/acre is, however, an exceptionally high yield for unfertilized grassland and it is felt that results at Tuchila are of more general application.

Management

A management trial was carried out at Chitedze to determine the effect of various numbers of cuts and various ways of applying nitrogen on the yield of Rhodes grass.

TABLE XXIII: EFFECT OF CUTTING AND APPLICATION OF NITROGEN ON RHODES GRASS

(*yields in* ' 00 *lbs. green material*)

Sulphate of Ammonia		*Application*		*Number of Cuts*	
0 lbs./acre	81.1	All at once	191.9	Once for hay	162.8
300 lbs./acre	140.8	Two applications at interval of 6 weeks	163.8	Twice at an interval of 6 weeks	150.5
600 lbs./acre	214.4	Three applications at intervals of 3 weeks	177.0	Three times at intervals of 3 weeks	123.0
L.S.D.	11.5	L.S.D.	14.2	L.S.D.	11.5

The results confirm the two straight fertilizer trials, described, above in showing a very large increase in yield with the application of 300 lbs./acre sulphate of ammonia and show that applying the fertilizer all at once at the beginning of the growing season is better than applying smaller applications at intervals. This also is supported by the results from Tuchila. While cutting once for hay has given the highest yields the proportion of stem to leaf was of course much higher than where the herbage was cut at intervals of six weeks, *i.e.* without allowing the grass to flower. The drop in yield with this method is only just significant.

ROTATION EXPERIMENTS

Work on long-term experiments continues at various stations, together with a short-term trial designed to bring out the effect of different preceeding crops on the following crop. The results of two trials at Tuchila and Chitedze show that in every case, growing a crop on the same ground for two years running is inferior to following a crop with one of a different sort.

TABLE XXIV: EFFECT OF FOLLOWING VARIOUS CROPS WITH VARIOUS OTHER CROPS

Preceeding Crop	*Yields maize (lbs./acre)* 1954	*Preceeding Crop*	*Yields tobacco (lbs./acre)* 1954
Groundnuts	2,643	Groundnuts	£19– 9s– 7d
Tobacco	2,505	Maize	£14–19s–10d
Cotton	2,299	Cotton	£12–17s– 8d
Maize	1,716	Tobacco	£12– 5s– 5d
Maize with beans	1,618		

Preceeding Crop	*Yields maize interplanted with beans (lbs./acre)* 1954	*Preceeding Crop*	*Yield groundnuts (lbs./acre)* 1954
Tobacco	3,955	Maize with beans	842
Groundnuts	3,188	Maize	819
Maize with beans	2,018	Cotton	808
Maize	1,978	Tobacco	715
		Groundnuts	607

These figures are means for the two stations

TOBACCO

Dark Tobacco

General

All experiments on dark tobacco were carried out at the Agricultural Research Station, Lilongwe, or the Agricultural Experiment Station, Tuchila, or at both places.

Varietal Improvement

Reports from both the United States of America and Canada indicate that the variety " Western " is as good as any of the standard varieties being grown in the world today. Thus work on varieties is confined to maintaining the characteristics of " Western ", conducting a search for desirable characteristics amongst other varieties and selecting for an improved " Western". Three single plant selections have shown promise and some bulking of these for seed will be done in the coming season, with a view to distributing one of them if further trials confirm past results.

Fertilizer Trials

These consist of factorial trials in which nitrogen, phosphate, potash and method of placement of the fertilizer were tried in all possible combinations. The results are shown in Table XXV.

Table XXV

	No Nitrogen		21 *lbs. N.*		42 *lbs. N.*		*Lowest sig. diff.* ($P=0.05$)	
	A.R.S.	*Tuchila*	*A.R.S.*	*Tuchila*	*A.R.S.*	*Tuchila*	*A.R.S.*	*Tuchila*
lbs./acre ..	687	1,298	950	1,511	1,074	1,588	77	75
Grade Index ..	65	56	71	61	74	63	—	—
Crop Index ..	44,722	73,084	67,697	91,512	79,374	99,579	6,851	7,083
	No Phosphate		19 *lbs.* P_2O_5		38 *lbs.* P_2O_5		*L.S.D.*	
	A.R.S.	*Tuchila*	*A.R.S.*	*Tuchila*	*A.R.S.*	*Tuchila*	*A.R.S.*	*Tuchila*
lbs./acre ..	863	1,468	908	1,447	941	1,482	77	75
Grade Index ..	70	61	72	59	71	60	—	—
Crop Index ..	60,144	90,078	64,920	85,113	66,730	88,985	6,851	7,083
	No Potash		90 *lbs.* K_2O		180 *lbs.* K_2O		*L.S.D.*	
	A.R.S.	*Tuchila*	*A.R.S.*	*Tuchila*	*A.R.S.*	*Tuchila*	*A.R.S.*	*Tuchila*
lbs./acre ..	875	1,411	943	1,508	893	1,479	77	75
Grade Index ..	73	64	70	60	69	57	—	—
Crop Index ..	64,108	89,773	66,341	90,652	61,345	83,750	6,851	7,083
	Dollop Side of plant		*Mixed at Planting station*		*Banded under ridge*		*L.S.D.*	
	A.R.S.	*Tuchila*	*A.R.S.*	*Tuchila*	*A.R.S.*	*Tuchila*	*A.R.S.*	*Tuchila*
lbs./acre ..	870	1,466	920	1,490	921	1,441	77	75
Grade Index ..	73	64	69	56	71	60	—	—
Crop Index ..	63,066	93,179	63,158	84,019	65,569	86,977	6,851	7,083

As in past years, nitrogen was again outstanding and the response to phosphate and potash was not significant. Method of placement of the fertilizer was significant at Tuchila only and there the significance was in favour of the dollop, where the fertilizer is applied in a hole approximately 3 ins. to one side or both sides of the plant.

On lands which have been heavily cropped, it will pay to apply phosphate and potash as well as nitrogen. However, if one is limited in the amounts of fertilizer which one may apply, nitrogen in the form of sulphate of ammonia will give the greatest return.

In an experiment done at Lilongwe and Tuchila three rates of dung and three times of planting were compared in all possible combinations. The results are shown in Table XXVI.

TABLE XXVI

	No Dung		Dung					
			5 tons/acre		*10 tons/acre*		*L.S.D.* ($P=0.05$)	
	A.R.S.	*Tuchila*	*A.R.S.*	*Tuchila*	*A.R.S.*	*Tuchila*	*A.R.S.*	*Tuchila*
lbs./acre ..	909	1,266	909	1,408	910	1,496	114	181
Grade Index ..	52	68	50	73	48	74	—	—
Crop Index ..	47,537	86,272	45,079	102,228	43,247	110,654	12,763	16,641

	Time of Planting							
	1st Planting		*2nd Planting*		*3rd Planting*		(*L.S.D.* $P=0.05$)	
	A.R.S.	*Tuchila*	*A.R.S.*	*Tuchila*	*A.R.S.*	*Tuchila*	*A.R.S.*	*Tuchila*
lbs./acre ..	1,065	1,496	780	1,460	883	1,214	114	181
Grade Index ..	66	73	28	72	50	70	—	—
Crop Index ...	70,216	108,580	21,482	105,681	44,165	84,893	12,763	16,641

At Lilongwe the dung used was *khola* (kraal) manure which had been obtained in the dry season, and this is possibly a good reason for the lack of response to dung.

The first and second plantings at Tuchila were significantly better than the third planting but they were not significantly different from one another. At Lilongwe the early planting was significantly best but the late planting did better than the mid-planting, and this is believed to have been due to the rainfall distribution which helped late-planted tobacco on this station.

A priming and topping trial in which the treatments no priming and priming were compared with low topping and high topping in all possible combinations, was done at Lilongwe. Table XXVII gives the results of this trial.

TABLE XXVII

	Unprimed	*Primed*	*L.S.D.* ($P=0.05$)
Lbs./acre	1,602 ..	1,364 ..	102
Grade Index	58 ..	69 ..	—
Crop Index	93,463 ..	93,787 ..	12,274

	Low topping	*High topping*	*L.S.D.* ($P=0.05$)
lbs./acre	1,420 ..	1,546 ..	102
Grade Index	64 ..	62 ..	—
Crop Index	91,137 ..	96,113 ..	12,274

These results, which are from one season's work, indicate that it pays to prime dark tobacco, and that the yield and value of the crop may be increased by higher topping. Not priming actually lowered the value of *all* the leaves on the plant.

A spacing, number of leaves, and nitrogen trial was done at Lilongwe for the third successive year. The different levels of each factor and the results are shown in Table XXVIII.

TABLE XXVIII

Spacing	3 *ft.* × 2 *ft.*	3 *ft.* × 2½ *ft.*	3*ft.* × 3 *ft.*	*L.S.D.* (*P*=0.05)
lbs./acre	1,121	1,038	1,009	61
Grade Index	46	54	59	—
Crop Index	51,475	56,501	59,247	9,679
Mean No. of leaves	7.7	9.5	10.4	
lbs./acre	953	1,096	1,118	61
Grade Index	55	54	51	—
Crop Index	52,025	58,605	56,593	9,679
Nitrogen	21 *lbs. N.*	42 *lbs. N.*	63 *lbs. N.*	
lbs./acre	1,004	1,067	1,097	61
Grade Index	49	53	56	—
Crop Index	48,803	56,603	61,816	9,679

Yield, and what is more important, quality, improved with increased applications of nitrogen. 63 lbs. of nitrogen gave a significant increase in yield and crop index over 21 lbs., but not over 42 lbs.

Plants with a mean number of 9.5 leaves left on each plant gave a substantial increase in Yield and Crop Index over plants with a mean number of 7.7 leaves per plant, with only a slight drop in the Grade Index. This is in agreement with last season's trials, except that in last season's trial the Grade Index remained constant.

Three years results have left no doubt that yields are increased with the closer spacings tried but the results for the Crop Index have been variable. In the 1951/52 trial the Crop Index showed a non-significant increase, in the following season the increase was significant and in the past season there was (as is shown in Table XXVIII) a significant decrease. There is therefore no real evidence for planting dark tobacco at closer than the standard practice of 3 ft. × 3 ft.

Rotations

A rotation and fertility experiment in which the effects of one crop after another crop, with and without fertilizer, was tested, gave the following results after the first test year.

Tobacco yielded highest after groundnuts and lowest after tobacco.

Maize intercropped with beans, and maize alone, did well after tobacco, whereas groundnuts planted after tobacco did poorly.

The residual effect of the fertilizer (dung, nitrogen, phosphate or a combination of these) was not significant.

The following notes are of general importance:

1. The nitrogen, phosphate and potash, referred to in the experiments, was supplied by sulphate of ammonia, single superphosphate and muriate of potash, except where otherwise noted.

2. *Grade Index* is the value per lb., based on a system of points per grade instead of pence per grade. The number of points given to each grade is based on the relative value of one grade to another, irregardless of the price that is being

paid or the amount of one grade which is being bought in any one year. Its big advantage is that it allows the results of one year's experimental work to be compared with that of another year's work.

3. *Crop Index* is the Grade Index multiplied by the yield in lbs. per acre and is in effect the value per acre.

4. At the Agricultural Research Station the nurseries were good, planting out conditions excellent, plant stands good and the weather kind.

At Tuchila the nurseries were poor, heavy rains at planting time did considerable damage, and stands were poor. As a result, plant stands in the major fertilizer and dung and time of planting trials varied from 15 to 50 plants and the analysis had to be done on the mean return per plant per plot. For this reason, very little reliance should be placed on the findings from either of these trials unless they tend to verfiy the results of future trials.

Burley Tobacco

General

Last season, for the first time, formal experiments on Burley tobacco were carried out.

Varietal Improvement

Work on Burley varieties has been confined to observations on foreign varieties and those being grown in the country. To date the variety " Stand Upright " is considered the best but one introduction, " Barnet Special " has shown promise.

In an observation trial, done this past season, the following information was obtained on 14 varieties:

	Average weight (gms) per unit area [1]				*Per cent. Moisture expressed as oven-dry weight*		*Per cent. of Coloury Leaf*	*Yield per acre (lbs.)*
	Wet weight [2]		*Dry weight* [3]					
	Red	*Coloury*	*Red*	*Coloury*	*Red*	*Coloury*		
Broadleaf resistant ..	0.051	0.039	0.042	0.032	21	22	2	906
Stand upright	0.051	0.036	0.039	0.029	31	24	30	919
Harmony ..	0.050	0.035	0.039	0.028	28	25	9	838
Judy's pride	0.049	0.034	0.039	0.028	26	21	25	833
Green briar	0.048	0.038	0.037	0.031	30	23	27	837
Harrow velvet	0.048	0.031	0.039	0.026	23	19	5	894
Kentucky 41A	0.047	0.035	0.038	0.028	24	25	22	848
Kentucky 16	0.047	0.032	0.037	0.028	27	14	15	1,046
Mammoth Ky. 22 ..	0.046	0.030	0.039	0.025	18	20	47	842
Kentucky 19	0.045	0.035	0.036	0.028	25	25	14	979
Ottawa strain 50194 ..	0.044	0.039	0.036	0.032	22	22	3	829
Kelley ..	0.043	0.036	0.033	0.029	30	24	21	757
Burley 1 ..	0.043	0.030	0.034	0.023	26	30	21	1,047
Haronova ..	0.039	0.029	0.032	0.024	22	21	9	751

1. Unit area is equivalent to 8 sq. cms. leaf made up of ten equal sized discs cut out of various parts of a leaf.

2. Wet weight is the average weight in grams of the unit area at a constant relative humidity of 84 per cent.

3. Dry weight is the average weight in grams of the unit area when done on the Carter-Simon Moisture Tester at 130° C for six minutes.

The table is arranged in order of weight per unit area of red leaf. It is noticeable that Stand Upright, a standard variety, has a high leaf weight and a good capacity for absorbing moisture, as well as having the second highest percentage of coloury leaf. Mammoth Kentucky 22, while having a very high percentage of coloury leaf, does not absorb as much moisture as others and so is not so desirable to the manufacturers. Green Briar and Judy's Pride are two more with good characteristics and should give a leaf of a desirable type.

Fertilizer Trial

This trial was similar to that laid down for dark tobacco, with the exception that here the fourth factor was spacing.

The treatments and results are shown in Table XXIX.

TABLE XXIX

				L.S.D.
	No Nitrogen	32 *lbs. Nitrogen*	64 *lbs. Nitrogen*	(*P*=0.05)
lbs./acre ..	949 ..	1,118 ..	1,250 ..	63
	No Phosphate	19 *lbs.* P_2O_5	38 *lbs.* P_2O_5	
lbs./acre ..	1,092 ..	1,091 ..	1,134 ..	63
	No Potash	90 *lbs.* K_2O	180 *lbs.* K_2O	
lbs./acre ..	1,121 ..	1,112 ..	1,084 ..	63
	3*ft.* × 18 *in.*	3 *ft.* × 24 *in.*	3 *ft.* × 30 *in.*	
lbs./acre ..	1,166 ..	1,132 ..	1,019 ..	63

The increased yields, due to applications of nitrogen, are very noticeable. Thirty-two lbs. of the element N per acre gave an increase of 170 lbs. and 64 lbs. of N per acre gave a still further increase of 132 lbs.

Phosphate and potash were not significant.

The 18 ins. and 24 ins. spacing between plants in the ridge gave significant increases in yield over the 30 ins. spacing but the difference in yield between the 18 ins. and 24 ins. was not significant itself.

FLUE-CURED TOBACCO

General

All experiments on flue-cured tobacco were carried out at the Experimental Sub-Station at Lisasadzi in the Kasungu District.

Fertilizer Trials

These consisted of two factorial trials in which the major elements nitrogen, phosphate and potash, along with method of placement of the fertilizer, were done at three different levels for each factor and in all possible combinations. One trial done on land, which was under natural grass the previous season, gave the results shown in Table XXX.

TABLE XXX

	lbs./acre	*Crop Index*	*Grade Index*
75 lbs. S/A	634 ..	17,010 ..	26.8
150 ,, ,, ...	854 ..	24,351 ..	28.5
225 ,, ,, ...	1,040 ..	28,383 ..	27.3
No supers	804 ..	21,683 ..	27.0
500 superphosphate ..	823 ..	22,687 ..	27.6
1,000 ,, ...	901 ..	25,373 ..	28.2
No potash	824 ..	22,994 ..	27.9
150 Mur/Sul/Potash	873 ..	23,612 ..	27.0
300 ,, ,, ...	831 ..	23,137 ..	27.8
Fertilizer in dollop ..	863 ..	24,253 ..	28.1
,, in single band ..	876 ..	23,619 ..	27.0
,, in double band ..	787 ..	21,871 ..	27.7
L.S.D. (P=0.05)	81 ..	2,609 ..	—

In the analysis of variance, nitrogen was highly significant, phosphate significant, and potash and method of fertilizer application not significant.

One hundred and fifty lbs. sulphate of ammonia gave a significant increase in Yield and Crop Index, and the Grade Index was also higher. While a further 75 lbs. of sulphate of ammonia gave a still further increase in Yield and Crop Index the Grade Index dropped. This is in line with past work and bears out the generally accepted fact that the nitrogen requirements for flue-cured tobacco are not above 36 lbs. nitrogen per acre.

The second trial, done on land which had tobacco including a similar trial the year before, gave the following results.

TABLE XXXI

	Yield lbs./acre
Sulphate of Ammonia rate in lbs./acre	
75	854
150	928
225	1,030
Superphosphate	
nil	931
500	919
1,000	962
Muriate and Sulp./Potash	
nil	849
150	964
300	1,000
Method of Fertilizer placement	
Dollop	912
Single band	948
Double band	953
L.S.D. (P=0.05	84

In the yield analysis nitrogen was highly significant and potash was very significant. The results of this trial are of particular interest in that (1) two fertilizer trials done in two consecutive years in the same field but in a different location have produced similar results; (2) in another trial done this year in a different field potash was not significant; and (3) the potash results of these experiments over the two years are confirmed by this year's chemical analysis, which showed this field to be low in potash, (0.19 m.e. per cent. K), and the other high in potash (0.35 m.e. per cent K).

The chemical analysis has therefore explained the probable reason for lack of response to potash in past years. It seems likely that some land in this area has enough potash when first cultivated. But since other fields may not have sufficient it would not be safe to omit potash from a mixture without a soil analysis.

DISEASE

Alternaria longipes

For the last three seasons this disease has made sporadic but excessively severe attacks in the Kasungu area. In the previous season the Lisasadzi Station was comparatively free but this year the crop was devastated. The attack was so severe that the yield was one quarter of that of the previous year and the average value per lb. less than half. So far there is no full explanation for the violent intensity of the attacks that have caused such great losses in the Kasungu area in recent years.

In one fertilizer experiment the leaf was graded according to the amount of spot (a very high percentage of this being due to *Alternaria longipes*) and points were awarded per lb. of each grade. The results were as follows:

(1) Applications of nitrogen as high as 46 lbs., N per acre and of P, as high as 190 lbs., per acre had no obvious effect on the incidence of spot.

(2) 150 lbs./acre of a muriate and sulphate mixture did reduce the incidence of spot, as did also the band method of fertilizing though not to the same extent as the potash.

As in the previous season a questionnaire on this disease was submitted to all estates. From the return of these questionnaires it was possible to examine 27 plantings and deduce the following information:

Varieties: No increase or decrease in the disease can be attached to any one variety.

Fertilizer. The plantings free from the disease had had more of all three elements, particularly of phosphate and potash. Side-dressings and whether the fertilizer was applied in a dollop or band had no noticeable effect.

Primings. The effect of these was impossible to assess as priming was done in only two cases.

Stalks. The method of handling: whether they were ploughed in or carried off and burnt had no noticeable effect.

Time of planting and previous crop. The early plantings on the different estates seemed most affected with the disease but on closer examination all the severely infected early plantings, except for one, had had tobacco on the same land in the previous season. It is thus confirmed that it is highly dangerous to plant two consecutive crops of tobacco in an area where their incidence of *Alternaria* is high.

TUNG

The Tung Station is now conducting 17 major experiments or trials on tung. Eight of these are held on the station and the remainder on estates on the Vipya and in Cholo and Zomba Districts. Four were set out this year.

1.1. Production of Improved Planting Material

1.1.1. *Buddings versus Seedlings*

This experiment, planted in 1940, is the oldest on the station and now contains some of the oldest trees in Nyasaland. Thus it is useful to keep it going as a classic.

Buddings on *montana* stock continue to be the highest yielders over buddings on *fordii* stock and selected and unselected seedlings; but for the first time there is no significant difference between *montana* and *fordii* stocks. In fact this year's yields on *fordii* exceeded the record of 1952 (1953 was an " off " year). A record yield was expected of all mature tung this season but the rains failed after the first two months and, due to the unusually dry months from January onwards, immature fruit fall was excessive and those fruits which did set were noticeably below average size. Thus the question poses itself whether mature trees budded on *fordii* stock are more drought-resistant than those budded on *montana*.

TABLE XXXII: BUDDINGS VERSUS SEEDLINGS 1954

(*Yield in lb. air dry seed per tree*)

Treatment	*Clones*				*Means* 1954	*Means* 1952
	M8	M13	H14	F9		
Montana stock	42.9	49.2	43.7	37.9	43.4	50.3
Fordii stock	37.4	43.7	51.8	39.3	43.1	35.9
Selected seedlings	31.3	21.1	22.6	23.3	26.3	36.4
Unselected seedlings (no clones) ..	—	—	—	—	17.9	21.0
Means	37.2	38.0	39.4	33.5	32.7	35.9
					1954	1952
		L.S.D.		P=0.05	9.8	13.3
				P=0.01	13.6	18.4

1.1. 2. *Clonal Trials*

From two clonal trial, planted 15 years ago, it appears, after all, that the A-types are not going to outyield the vigorous B-types. The time is nearly ripe for a really discriminating summary of the best clones to be made. There is insufficient space for such a work in a Part II Report and the tables below will suffice as a brief summary of what sort of yields might be expected.

In two experiments containing various clones, clones have yielded as follows:

TABLE XXXIII: CLONAL DIFFERENCES IN N. FERTILIZER TRIAL ON THE TUNG STATION, AGE 14 YEARS

(*Yield in lb. air dry seed per tree*)

	N24 (*A-type*)	10 *Vig. B-type*	14 *Vig. B-type*	M8 *A-type*	F9 *B-type*	*Sig. Differences* $P=0.05$	$P=0.01$
Yield per tree ..	48.7	45.7	40.3	38.5	30.5	6.2	8.2

TABLE XXXIV: CLONAL DIFFERENCES IN N.P.K. WITH DUNG TRIAL ON THE VIPYA, AGE SEVEN YEARS

Yield in lb. air-dry seed per tree)

Clone 04 *Vig. B-type*	14 *Vig. B-type*	M13 *A-type*	C2A *A-type*	*Sig. Differences* $P=0.05$	$P=0.01$
17.4 ..	13.4 ..	11.0 ..	3.6 ..	5.0 ..	6.8

Thus it can be seen that, for the Vipya conditions, 04 is superior to one of the best clones recommended on the Tung Station *i.e.* M13. The low yields of C2A are probably due to a preponderance of male trees.

TABLE XXXV: YIELD IN LB. AIR-DRY HULLED SEED PER TREE*

Type	Clone	Age in years						Total	Mean	Remarks
		7	10	11	12	13	14	10–14	10–14	
A.	M13	16.9	50.4	24.4	54.4	20.4	49.3	199.1	39.8	Two of best original clones
	M8	14.8	50.0	27.5	56.5	27.2	42.9	204.1	40.8	
	C2A	16.2	26.5	7.1	38.9	—	—	(88–7)	24.2	
	H14	14.8	42.7	22.4	56.7	20.1	43.7	185.6	37.1	
	E460	5.5	33.8	—	—	—	—	—	—	
	N24	12.7	38.2	25.5	49.2	22.3	53.3	188.5	37.7	
Vigorous B.	E424	18.8	31.9	—	—	—	—	—	—	
	E464	27.8	38.4	—	—	—	—	—	—	
	14	21.5	39.5	41.8	47.7	24.4	43.9	197.3	39.4	
	10	25.2	40.9	37.6	53.2	9.6	52.9	194.2	38.8	
B.	N4	3.8	9.0	4.1	—	—	—	—	—	N4 liable to pronounced biennial bearing and die-back
	F9	11.2	31.8	17.3	36.7	7.2	35.0	128.0	25.6†	
	4	13.		—	—	—	—	—	—	

* Yield per acre can be calculated as follows:

A-type spacing of 30 ft.× 30 ft. or 50 trees per acre.

Vigorous B-type 27 ft.× 27 ft. or 60 trees per acre.

† Actual spacing was 27 ft.× 27 ft. so as to fit in with other clones.

The highest yield ever achieved in a close planting trial was 4,500 lbs. per acre. Thus the yield of 25.6× 200=5,120 lb./acre would be purely theoretical, although not necessarily impossible.

Year 7 of the above figures may be compared with some newer budded clones planted in clonal trial in 1947, the best of which yielded as follows: in 1954 (*i.e.*, at seven years old):—

Clone	E658	G107	G107	F225	E565	G43	G112	G87	E362	G56
Mean yield per tree	32.4	31.4	26.9	26.1	24.8	24.7	24.1	23.8	23.2	22.5

Most of these are vigorous B-types and there is no doubt that future plantings or replantings of vacancies should consist of these clones in preference to the older ones.

Work on three new experiments continues but it is too soon to take yield records. They are:—

(1) Trial with budded plants of eleven promising A-type seedlings compared with M8. (On an estate in Cholo District.)

(2) Trial with crossed and selfed B-type seedlings of *Aleurites montana* to be compared with named seedlings of *A. fordii* of American origin.

(3) Replication of (2) on an estate.

Selection of promising *fordii* seedlings on an estate continued. Seed of several types, selected for cluster habit of fruit and/or good branch system, have been sown to see if the F1 generation comes true to type.

1.2. Cultural Practices

1.2. 1. *Intercropping and Cover Crops*

An experiment compared the following intercrops:

(1) Soya Beans every year.

(2) Maize and a legume alternate years.

(3) Permanent cover crop of *Glycine javanica*.

(4) Grass and weed cover slashed twice a year and mulched round the trees with 1 lb. sulphate of ammonia to each tree.

The trees were planted in January, 1948, and their yields recorded from 1948 onward showed no significant difference in the treatments until 1951.

Table XXXVI: Intercropping Trial

(*Mean yield in lb. air-dry seed/acre*)

Years	*Treatments*				*Sig. Differences*	
	1	2	3	4	$P=0.05$	$P=0.01$
1949	241	280	168	252	Not significant	
1950	431	392	291	274	Not significant	
1951	330	325	140	370	146	202
1952	1,101	1,220	497	828	389	538
1953	297	347	274	386	Not significant	
1954	1,988	2,106	874	1,534	582	812
Totals	4,388	4,670	2,244	3,644		
Means	731.3	778.3	374	607.3		

Thus it can be seen that treatments Nos. 1, 2 and 4 are superior to treatment No. 3. The Glycine, rather surprisingly, has produced a depressing effect, but it may be because this treatment is not cultivated and has no added nitrogen. It is interesting to note that treatment 4, while lower than 1 and 2 on the average and in the "on" years, is not significantly different in the "off" years. As this treatment requires less labour than the others it is one that can be recommended.

Owing to the unsatisfactory nature of this experiment (*see* last year's Part II Report) and owing to the demand for economy in tung production, resulting on the drop in the market price of tung, a new experiment of a different design has been devised to test various inter-crops of a labour-saving nature and to compare their effect with a cultivated intercrop such as maize (representing normal estate practice).

The treatments selected are (1) Fish Bean (*Tephrosia vogelii*), (2) Pigeon pea (*Cajanus indicus*), (3) Velvet Bean (*Stizolobium atterrinum*), (4) Grass and weed cover slashed twice a year, and mulched round the trees with 1 lb. sulphate of ammonia to each tree and (5) maize. Each plot (1–3 and 5) to receive 2 lbs. sulphate of ammonia as a standard dressing in October. The man-hours spent on each treatment will be recorded in addition to the effect of the treatment upon the yields.

On the Vipya, conditions are somewhat different from those pertaining to Cholo District and even different clones are favoured. (*See* 1.1.2 above.) Thus a further experiment has been set out to study the effects of the following treatments:—

(1) Clean weeding, (2) velvet beans (annual legume) disced as green manure, (3) soya intercrop, (4) grass strips (*Panicum Makarikari*), (5) soya to be followed by perennial legume at maturity, and (6) standard estate practice of slashing grass.

1.2.2. *Spacing Trial*

A spacing trial was described in the Part II Report for 1951. This had to be abandoned for several reasons and now that it is economically desirable to reduce costs in tung production, a further experiment has been devised to see how quickly a close-planted plantation can come into economic bearing and what subsequent thinning will be necessary.

1.3. Fertilizer Trials

1.3.1. *N.P.K.*

The original N.P.K. factorial experiment, planted in December, 1946, still shows a significant response to nitrogen (P=0.01), although no fertilizer had been applied since December, 1950. Plots receiving 3 lbs. sulphate of ammonia produced an increase in yield of 316 lb./acre, compared with a yield of 1,822 lb./acre for the experimental mean (Sig. Diff. at 1 per cent.=122 lb./acre). The standard treatment throughout all plots was an intercrop of pigeon pea. Standard error was lower than for past year's, being 19.8 per cent. of the G.M., the yield for this field being a record.

Another N.P.K. factorial, planted in 1948, under different conditions (*i.e.* the Vipya), has for the last two years shown a response to nitrogen and nearly to phosphate. The soil is poorer and phosphate reserves may be expected to be depleted more quickly (comparable to some estates near Zomba). In 1954 there was a response to nitrogen (P=0.01) and it appears that 1 lb. sulphate of ammonia per tree is almost as effective at this age as 3 lb. The standard error for the experiment is 39 per cent. of the G.M. which is high but is in the order to be expected for such an experiment in its early years. The clone used for the experiment was 04.

1.3.2. *N.P.K. with Copper and Zinc*

The factorial experiment started in October, 1950, and described in last year's Report, has not yet produced significant results, although a response can already be seen to applications of N, NP and P. Yields this year were good for the age of the trees (seven years) the experimental mean showing a yield of 1,142 lbs. per acre. The standard error was low, being 19 per cent. of the general mean.

An experiment of the same age on eight year old trees on an estate near Zomba, where the conditions are somewhat drier and soil poorer, has, however, already shown a significant response to nitrogen and is beginning to show a response to zinc. The combination of the two, NZ, however, appeared to depress the yield; the same applies to P and K.

Table XXXVII: N.P.K. with Copper and Zinc

(*Yields in lb. dry-seed per acre*)

Years	*Exptl. mean*	*Treatment effects* *N.*	*Z*	*Sig. Differences* *P*=0.05	*P*=0.01	*Remarks*
1952	1,141	4	64	100	—	" On year
1953	361	95	40	37	50	" Off " year
1954	825	193	95	137	185	" On " year reduced yield due to lack of rain

N=3 *lbs. sulphate of ammonia per tree.*

Z=3 *ozs. zinc sulphate per tree.*

A third experiment is in its second year (on six year old trees) on the Vipya; there is no significant response to record at this stage.

A poor sandy block of one of the experimental fields has a history of zinc deficiency symptons (*see* Part II Report for 1951) but applications of copper and zinc at varying levels from October, 1951, onwards have, however, failed to produce any significant response. There seems to have been a greater effect on the low-yielding trees than on the high-yielding trees.

1.3.3. *N.P.K. with Dung*

The results of an experiment started on an estate in 1948 were reported last year. Yields for 1954 were, however, less than for 1952, due to the extremely dry season and only N. produced a very significant increase (P=0.01) whereas ND and NP produced a decrease over the experimental mean.

TABLE XXXVIII: N.P.K. WITH DUNG TRIAL

(*Yields in lb. air-dry seed per acre*)

Years	*Exptl.*	*Treatment effects*						*Sig. differences*	
		Mean	*N*	*P*	*D*	*PD*	*NP*	*P*=0.05	*P*=0.01
1952	998	211	106	128	92	−34	−50	88	117
1953	308	137	0	53	40	−51	−7	39	52
1954	634	256	549	80	82	—	−52	102	136

A series of observational plots on different soils of the Vipya, planted in 1947, have not yet shown any significant response. This is to be expected since the treatments have not been applied regularly. However, the highest yielding plots are those which have received nitrogen.

1.3.4. *Nitrogen*

The experiment started in 1949, with treatments at 0, 2, 4 and 6 lbs. of sulphate of ammonia per tree, still does not show any significant results between the various nitrogen treatments. 4 lbs. of sulphate of ammonia however, shows an increase over none at 1 per cent. significance.

This field has two supposed disadvantages: (1) Its previous use as an intercrop experiment (*see* Part II Report for 1951). (But an analysis of covariance showed no significant regression; *i.e.* the experiment under study did not appear to be affected by the previous experiment.) (2) The absence of guard rows.

The latter is of some importance and two new experiments have been devised on estates growing tung under different conditions. These experiments have been designed to show the optimum levels of nitrogen to be applied in the form of sulphate of ammonia and tung cake and the best time of applying the former.

1.4. OTHER TUNG EXPERIMENTS

1.4.1. *Biennial Bearing*

It has already been explained in paragraph 1.1.1. that yields were universally higher than 1953 and in the case of mature trees, on a par with 1952. This behaviour is in accordance with the habit of biennial bearing to which tung is prone (*see* Tables XXXVI, XXXVII and XXXVIII). Thus a small experiment has been planned to try various means of correcting this habit; if it were impossible to overcome the habit, it would at least be desirable to reverse the " on " and " off " years of half the plantation, so that the total yearly yield would not fluctuate as severely as recently. Treatments are: (1) Double applications (6 lbs.) of sulphate of ammonia at the beginning of the rains in the " on " year and none at the beginning of the " off " year. (2) Remove half

the flower buds per tree at the beginning of the growing season of the " on " year. (3) Combination of (1) and (2). (4) Control; no treatment. (5) Defoliating spray during the growing period of the " off " season. 1954 was an " on " year and treatment numbers 1 to 3 were carried out. It appears that more lateral growth was made on theseplots than on No. 4; it is hoped that analysis of the yields next season, 1955, will show a better yield for the " off " year.

1.5. Tung Diseases

1.5.1. *Botryosphaeria*

Methods of combating this disease on tung have been discussed in last year's Report. The cost of spraying with copper compounds was shown not to be economic. In the United States of America two new fungicides are recommended for *Botryosphaeria* control. They are Zinc ethylene bisdithiocarbamate (Dithane Z-78 or Blitane) and Dinitro phenyl crotonate (Karathane W.D.) and samples have been received for testing here. However, even if they were effective, it appears that the present price of tung would make their use uneconomic, but it is hoped that the experiment will not always be only of academic importance.

1.5.2. *Dieback of shoots and premature fruit fall*

From one of the estates was reported a serious case of dieback of shoots and fall of immature fruit at all stages of growth from fruit set onwards. The symptoms were apparently aggravated by the unusually dry season. No causative pathogen could be found on samples sent to the Commonwealth Mycological Institute, and, in the absence of a Plant Pathologist, it has been necessary to postpone further study of the disorder until next season.

COFFEE

Cultivation Experiment

The high price obtained for coffee on the world market has resulted in a renewed interest in Arabian coffee. Experience elsewhere has shown that the necessity for shade varies with local conditions, one of the important factors being rainfall; in low rainfall areas shade competes too strongly with coffee.

Thus an experiment was planted in December, 1953, to test the reactions of coffee to all combinations of shade and surface mulch. The layout was a Latin square with the treatments:—

1. Mulch with elephant grass. No shade.

2. No mulch. Shade of tall bananas at 18 ft. × 18 ft. to be followed by *Grevilea robusta* at 36 ft. spacing.

3. Shade of *Sesbania punctata* at 18 ft. × 18 ft. to be followed by *Albizzia Lebbek* or *A. stipulata*.

4. Treatments 3 and 1 combined.

The coffee was planted at a spacing of 9 ft. × 9 ft. The bananas and *Sesbania* will be removed when the *Grevillea* and *Albizzia* are large enough—say in five years.

The experiment was replicated on a neighbouring estate where the rainfall is somewhat higher.

On the experiment at Bvumbwe has been superimposed an N.P.K. factorial experiment. Within one growing season the *Sesbania* seedlings produced adequate shade and it has been necessary to trim all branches to a height of 4 ft. This season was extremely dry, only 26.55 ins of rain having fallen in the rainy season and 3.01 ins. in the dry season (10 year average 46.25 ins. and 4.38 ins. respectively). At

the time of writing there are still two months to go before the rains are due to break; the coffee which was not mulched has suffered most and wilting has been severe in the *Sesbania* plots where competition for available water must be fierce. The mulched plots are the healthiest, but without shade chlorosis of the foliage is severe. There are no observable differences in the split plots of N, P and K.

Variety

Elsewhere it has been shown that different varieties of *arabica* favour different localities. Thus a collection of 24 varieties is being raised at Bvumbwe to provide material for a variety trial to be planted in December, 1955. As with the shade/mulch experiment, this trial will be replicated on a private estate.

Arabica Coffee Trial at Nchenachena

An experiment was planted out in January, 1953, to compare—

Local variety v. Kent hybrid.
Effects of nitrogen, phosphate and dung.
Single v. multiple stem pruning.

In addition, half the blocks are planted with shade trees to observe the effect.

In this, the second season, the outstanding effect is that from nitrogen and from dung, Kent hybrid also appearing more vigorous than the local variety. Phosphate so far has had little apparent effect. A small crop was taken this season, after thinning.

8. In addition to " local " and Kent hybrid, 12 other strains of coffee obtained from Lyamungu and Mbosi are under observation at Nchenachena; at least eight of these are promising so far. At Champoyo 14 varieties of coffee (12 plants of each) were planted out this season. Much of the planting material was poor and an appreciable number have died. Growth has been poor, despite application of dung and a light dressing of nitrogen at planting. Three other trial plots of coffee were planted out on the Vipya, near the main road in the catchments of the Chauteka, Lambilambi and Rumpi Streams respectively. Growth has been very poor to date.

Robusta Coffee

Seeds sown in 1953 was planted out this season at Banga and Luwazi (Nkata Bay District) in duplicated plots to observe the effects of nitrogen, phosphate, mulch and shade. Growth to date has been satisfactory. Flowering started in September on some of the bushes (but most of the flowers are being removed). A trial plot was also planted out at Yembe Hill (Karonga District).

Coffee Disease

A serious dieback disease, suspected to be a species of *Fusarium*, is under investigation. It is threatening coffee plantings in the Cholo District. Until control measures can be recommended, growers are strongly advised to enforce a strict regime of cleanliness and a high standard of cultivation in their plantations.

FRUIT

Variety Trials

Tung Station: Variety trials have been established of the following kinds of fruit trees: peach, plum, apricot, almond, loquat, quince, guava, fig and pecan. Varieties of grape, the purple granadilla and thornless youngbery have been trained on wires; there are also trials of strawberry and apple rootstock clones.

Promising varieties will be propagated for distribution in Southern Province so as to supplement the work already established at Mwera Hill.

Mwera Hill

Deciduous Fruit

Almonds: Three varieties under trial—Britz, Paper Shell and Jordan. All growing well but Britz is the only one to yield fruit as yet.

Apples: Blenheim Orange is still the most productive variety. Versfeld and Cox O.P. still under observation. Four other varieties recently imported—Delicious, Reinette du Canada, Rome Beauty and Eickoff's seedling.

Apricot: Two varieties under trial, Early Cape and Royal. The former is proving to be the more vigorous and productive.

Peaches: The early white-fleshed freestone varieties continue to do best. Mildew is the most serious trouble particularly under irrigation.

Pears: In common with other decidous fruit, most varieties suffer from prolonged rest. Le Conte bears well but quality poor. Keiffer Hybrid is better quality and the most promising variety. Doynne du Comice discarded as unsuitable.

Plums: Satsuma and Santa Rosa are the best varieties tried.

Quince: Meeches Prolific found to be the best bearer and grows well.

Walnut. Not suitable. Growth too slow.

Vines: Isabella is the only suitable one tried.

Figs: Two varieties under trial, Adam and White Adriatic, the former has the better quality fruit but the latter bears well.

Citrus Fruit

Washington Navel, Joppa and Valencia Late Oranges are suitable varieties for local conditions. Also Villa Franca Lemon and Tahiti Lime. Growth of Citrus rather slow at Mwera Hill due to low temperatures. Periodic spraying necessary to combat scale, psylla and aphis.

Cover Crops

Various plants are being tested for suitability as cover crops in an orchard. After one season's growth the following notes have been recorded:—

Buckwheat. The Indian Strain, Tata 7, provides a good cover in a very short time and is an effective smother crop for undesirable weeds if sown in 9 ins. drills or broadcast. A sowing made in December could be ploughed in as green manure in February or harvested late in March. The flowers attract bees and would provide food for them when the fruit was not in flower.

Indigofera endecaphylla, a legume, formed an ideal cover when sown in 12 ins. drills within six months of sowing. It would probably give a good cover in 2 ins. rows. It is a trailing herb with a strong taproot and is indigenous to this part of Nyasaland. The trailing stems produce adventitious roots. It was attacked by the larvae of a leaf-eating beetle and was originally rejected for this reason as a cover crop for tung. However, two sprayings of a 0.5 per cent. BHC/5 per cent. DDT. mixture at ten-day intervals very effectively controlled this pest. As fruit would have to be sprayed sooner or later, it is worth considering as an orchard cover crop. Another species, *I. hirsuta*, has not produced such satisfactory growth.

Glycine javanica, another legume, formed an excellent cover in the first season. Although it has been recommended as a cover crop in citrus orchards elsewhere, experience at Bvumbwe has been that it becomes rather smothered by the indigenous flora, after a few years. Thus *Glycine* should probably be ploughed in after a period of about three years. This would be a good thing as a permanent cover has been found to produce a depressing effect on fruit. The same remarks probably apply to *Centrosema pubescens*. *Teramnus uncinatus* and *Calopogonium mucunoides* which form similar covers. At Mwera Hill the growth of *Glycine javanica* is very slow.

Stylosanthes gracilis. This legume forms a good cover when sown 18 ins. drills. For a mature orchard it would be possible to make use of a fodder mixture such as Rhodes grass (*Chloris gayana*) or African Foxtail (*Cenchrus ciliaris*) in conjunction with one of the four climbing legumes mentioned above or with *Desmodium intortum* which is more vigorous. Should a cash crop be required as an interplant, the soya or one of the kidney beans would be suitable.

Other plants were tried and the following considered not suitable.

Too weak:—*Trifolium Johnstoni* and Lucerne (*Medicago sativa*), unless irrigated.

Diseases

Russet on citrus. On an estate, an orchard of various kinds of citrus was reported to be suffering severely from russetting of fruit such as to make them unattractive for sale. In co-operation with the Entomologist a series of spraying and dusting treatments was tried. The casual organism was identified as a mite and the most efficacious control appeared to be lime sulphur.

4. Literature

A Bulletin on "*Fruit Growing in Nyasaland*" was published this year.

A pamphlet was prepared for the guidance of granadilla growers.

REPORT OF THE AGRICULTURAL CHEMIST

A. Oils and Oil Seeds

Tung Oil

Factory Control. With the regular use of the drier installed at one factory, it has been possible to commence expelling earlier than usual, and thus further reduce the chances of any damage to the seed on storage. Routine examination of export consignments continued. An outstanding feature is that control in the field and factory is now such that the acidity of the oil is uniformly low, and even at the end of the season it was only 1 per cent. The value of this quality control is seen from the securing of fresh markets in South Africa and the absence of complaints or queries from buyers.

One point of interest this year was the effect of the extremely low rainfall on the oil content of the seed. It was generally noted that seed tended to be smaller, but analysis of samples, both from the Cholo and Zomba Districts, showed that the oil content was not affected. The oilcontent of the dry kernel was 63.9 per cent., and 65.2 per cent. the dry kernel content of dry seed was 65 per cent., and 61 per cent. respectively. The oil contents compare favourably with figures obtained in previous years (*e.g.* see Annual Report for 1951) but the kernel content of the Zomba seed appears slightly lower. Examination of the representative samples of seed, collected at the factory from consignments received, will resolve this point at the end of the current season. Such samples examined from the 1952/53 crop showed the content of dry kernel in dry seed to be 64.6 per cent., the kernel containing 64.7 per cent. oil, in the *montana* seed, the corresponding figures for the *fordii* seed being 67.7 per cent. and 66.7 per cent.

Groundnuts

Forty-nine varieties of groundnuts grown in native gardens or at experimental stations were examined for oil content, Only two of these had oil contents less than 45 per cent. (43.5 and 44.9 per cent.), and seven results were in the range 45–47 per cent., all the others had oil contents in the normal range of 47–50 per cent., accepted for Indian nuts. It was also significant that Chimbuwila seed, which comprises the bulk of Nyasaland production, had the high oil content of 49.1 per cent.

Cotton Seed

When poor germination of seed stored at one ginnery was obtained, samples of this, and of seed showing normal germination were received for examination. The free acidity of the oil extracted from seed of low germination was found to be 15.4 per cent., whereas that of the normal seed was only 2.2 per cent. It was clear therefore that lipolysis had occurred, due to the seed being wet either before or during storage. It was therefore decided that for the 1954 crop a close control should be maintained on all seed cotton received at the markets, and of cotton seed held in storage. American investigations have shown that lower germination is likely to occur with seed of high acidity, and that tendency to heat is increased where the initial moisture content and F.F.A. in the seed is high. The F.F.A. must also be considered from the economic aspect of yield of oil, a high F.F.A. greatly reducing the amount of refined oil obtained. A temperature of less than 90°F. and a relative humidity in the inter seed space of 65 per cent., was found advisable. Although high temperatures and moisture contents reduce viabilities, if one of these factors can be kept low—a higher limit can be tolerated in the other, this possibility being of importance in the high humidities and temperatures of the Nyasaland cotton areas. The equilibrium moisture contents for seed at different relative humidities were determined as follows:—

Per cent. relative humidity	.. 32	.. 66	.. 81	.. 90	.. 98
Equilibrium moisture content	.. 6	.. 9	.. 13	.. 16	.. 22

The relative humidity in the Lower River area during the months of seed-buying and storage is 80–95 per cent. in the early morning, falling to 45–55 per cent. in the afternoon. However, tests showed that seed dried to 10 per cent. moisture content took over one week to reach their equilibrium state at humidities greater than 90 per cent. It appears therefore that sun-drying would help to keep the moisture content low, and this is confirmed by the figures obtained up to the end of June. Ninety-two samples of cotton and cotton seed were examined. The moisture content of the seed cotton was 7–9 per cent., the acidity being 1.0–2.0 per cent. F.F.A. in the extracted oil. Thirteen samples had higher moisture contents at 9–12 per cent., and five samples acidities of 3.3–4.6 per cent. Storage tests are proceeding to see if present methods can be improved by ventilation or other means.

B. Soils and Nutrient Studies

Shire Valley Survey

Four hundred and seven samples from 124 profiles were examined. These soils varied from heavy clays, occasionally saline (maximum 0.14 per cent. Cl in the top soil) to fine sands on which irrigation would be uneconomic. Many calcareous soils were encountered the maximum carbonate content recorded being 15 per cent. In reaction the soils were generally in the pH range 6–8, although some sodium saturated soils giving a pH of 10.5 were encountered. The soils of the area were generally well supplied with phosphates and potash –the main need being for nitrogen and organic matter.

Departmental Projects

(*a*) *Experimental Stations*

Some 450 soils, carried over from the survey of the Department's Stations, made in 1952, have been analysed to see if data can be correlated with fertilizers responses obtained. A complete examination has not yet been possible, but the main need appears to be for nitrogen. Phosphate responses have generally been found where the available phosphate supplies are low. The geological formation of the country is such that the minerals supply adequate potassium to the soils, and figures for available potassium confirm the lack of response to potassium fertilizers which has been found.

(*b*) *Alimenda Sugar Scheme*

A full report of the soils and water data of this scheme was prepared. Two-fifths of the area is *dambo-makande* soil with occasional saline areas, which comprise approximately 10 per cent. of the lower parts of this type of soil. A further tenth of the area consists of silty fine sands and silt loams where seepage might occur, and there is an area of similar size which consists of sandy loams—but as this is far from the river, irrigation is problematical. The remaining two-fifths of the area is fine sandy soil, unsuitable for irrigation. Although more recent work has drawn attention to this less useful northern part, it appears that the necessary acreage of suitable soils for economic cane production would be available in the southern portion of the area. Such soils would be the *makande-dambo* clays and the silty loams. The occurrence of saline patches in the lower lying sections, with concentrations at toxic limits of 0.15 per cent. sodium chloride, at 2–3 ft., probably affords an explanation of lower sugar content of the cane found in such areas. From an experimental plot on such a saline area the sugar content was 7 per cent. as against 11 per cent. on the non-saline *makande* soil, these figures to be contrasted with the 11 –14 per cent. sugar in the cane of other producing contries. However, experiments have shown that the effect of this salinity on the cane can be largely overcome by assisted drainage.

Regarding the nutrient status of these soils, the general level of potassium and phosphates is satisfactory but organic matter and nitrogen are low. These facts are reflected in the fertilizer trials where nitrogen alone appeared to have any appreciable results on yields. Analysis of seasonal samples of the River Shire, showed that this water is quite suitable for irrigation. A representative analysis is shown below:—

River Shire Water

pH	7.4
Conductivity (25°C) millimnos)	2.21
P.P. 100.000	
Calcium	1.6
Magnesium	0.7
Sodium	2.2
Potassium	1.1
Chloride	1.1
Sulphate	0.4
Carbonate	2.7
Bicarbonate	18.9
Hydroxide	Nil

(c) *Chilwa Rice Scheme*

In December, 1953, it was reported that some of the rice on the experimental plots at Sombani was turning yellow and showing irregular growth. The area was visited in February and the most striking observation was that the rice at the edges of the plots was green and vigorous whereas in the centres the leaves were chlorotic and stunted. A full range of soil and leaf samples were analysed, and it appeared that the irregular growth was due to disturbance of the top soil when building banks separating the different trial plots. As is seen from the following figures, for a representative profile in the area, the top soil is very shallow and any removal of this will produce marked effects on soil fertility.

Depth	*pH.*	*Texture*		*Clay*	*Chloride*	*per cent.*		*m.e. 100 grm.*				*Available phosphate p.p.m.*
		Sand	*Silt*			*org. C.*	*N.*	*K.*	*Na.*	*Ca.*	*Mg.*	
0–3	6–0	30	16	49	0.01	2.7	0.13	0.9	1.3	17	11	31
3.12	6.2	27	16	54	0.02	0.9	0.07	0.3	2.2	22	15	15
36″	7.5	22	16	58	0.06	—	—	0.4	12.2	22	12	—
60″	7.0	23	17	58	0.15	—	—	0.4	10.5	23	16	—

The soils work reported above was supplemented by analysis of the green and chlorotic leaves, the results being summarized below:—

	Weight of air-dry leaf grams	*Composition of Dry Material*				
		N	*P*	*K*	*Cu*	*Zn.*
			%			*pp.m.*
Middle of Plot (chlorotic)	0.14	1.3	0.4	1.7	15	27
Edge (Green)	0.32	3.3	0.6	2.4	24	41

These figures confirm that the main cause of the chlorosis was the lack of major nutrients due to disturbance of the soils. Such occurances are reported as common in rice, the soil recovering after a few years, but it seems to have been particularly accentuated due to the shallow top soil of this area. The possibility of iron deficiency, induced by the higher lime content of these soils, being a contributory factor to chlorosis is also being examined.

A wider range of figures showed that the area of the proposed 100 acre experiment, consisted of moderately acid dark grey clay top soils becoming less acid and heavier in texture but uniform in colour with depth, until calcareous concretions are found

at 4 ft. & 5 ft. The salinity in the upper horizons does not reach the level of 0.1 per cent. NaCl, which is reported as toxic for rice. Comparison with soils obtained from the Kota Kota rice areas, showed that the Chilwa soils had rather better inherent fertility than those from Kota Kota.

On the north side of the 100 acre plot a horizon of pure sand was found at about 3 ft. and as this possibly represents a river bed which may occur nearer the surface elsewhere the extent of this sand is to be investigated. This will form a part of the soil survey to be made of the whole area, from which the 10,000 acres required for the full scheme is to be selected. It is hoped that it will be possible to complete this survey before the end of 1954.

Tea

(*a*) *Nutrient Status of Estate soils*

Most of these 271 samples were from tea estates, although the remaining samples from other estates is enabling a wide coverage of Southern Province soils to be obtained. From the analyses so far made, soils of the Cholo–Mlanje area are well supplied with potash and the available phosphate status is generally satisfactory ($>$ 25 p.p.m.). Where soils are low in phosphate, such fields are found irregularly on estates and this stresses the importance of soil analysis in assessing fertilizer requirements. In the Blantyre–Zomba sections there are found areas of lower phosphate and potash status, which at present cannot be related to the geology of the area.

Several interesting points have arisen from studies on Tea Estates. Where tea has been long established, the potash status of the soil is often lower (at 0.4 m.e.) than of neighbouring fields (0.8 m.e.) which have only recently been opened. The absence of data on the soils initially makes conclusions difficult, but this trend has now been noted in several cases, and suggests that more potassium is being consumed by the tea than is being released from the soil minerals. Even so the soil potash is still at a higher level than when potash deficiencies were noted in Ceylon. The leaching effects of the rains and of fertilizers must also be considered. Particularly must this point be watched now that more heavy applications of ammonium sulphate are being recommended. On one estate, where tea and tung had been planted for similar periods, the tea fields generally had a lower pH (5.0) than the tung areas (pH 5.9). This aspect is important on the lighter soils of lower base capacity.

The main outcome of all the work on estate samples, is the need for increased nitrogen supplies and for the conservation and efficient utilization of this and other applied fertilizers; by the preservation and building up of organic matter by shading and mulching of the soil wherever possible.

(*b*) *Physical Nature of Tea Soils*

It has previously been commented that micaceous areas do not provide the best tea soils, and an opportunity to study this problem more closely was provided when one estate reported the absence of expected responses to sulphate of ammonia. Soil profiles were examined in the various fields, and it was clear that where the soils were derived from dolerite or allied rocks of the basement complex, soils of satisfactory texture for root penetration and moisture retention were obtained. Where, however, biotitic gneisses were the parent material this developed into a very compacted clay which prevented root penetration below approximately 2 ft. Root development was therefore stunted, and the bushes had not been able to utilize applied fertilizers. The power of micas and biotites, to absorb ammonium ions may also have been a contributory factor. The estate had earlier adopted a short pruning cycle, and in the absence of shade, this had been one factor in restricting growth, but as this applied to

all areas, it was clear that the soil structure was the predominant cause. The possibility of breaking up the compacted horizons by introducing shade trees is being investigated.

(*c*) *Effect of Shade on Tea*

A series of experiments were made to see if it were possible to obtain evidence from soil and leaf analysis to indicate any preference between *Albizzia* (Chikwani) and *Grevillea* shade. Samples were taken from three estates and from Swazi Tea Station. The results were not definite, probably due to the fact that it is not easy to find blocks of shade which are not interfered with by wind-blown leaves from adjoining areas carrying various trees. At Swazi, where *Albizzia* exists in an otherwise open area, the most defined results were obtained.

	Swazi soils per cent. N
No shade	0.13
No shade+N	0.13
Albizzia shade	0.18
Albizzia+N.	0.17

On the other estates there was no appreciable difference between the soils under *Grevillea* or *Albizzia*; but both showed a higher content of nitrogen (ca 10 per cent.) than where there was no shade. Nutrients supplied by the different shade trees may be absorbed by the bushes, and they may not be fully reflected in the soil analysis. Yields of tea will therefore be the final criterion for assessment, but the soil analysis will be continued as time permits, since the quantity of leaf fall and shade may affect the organic matter status and physical condition of the soil. It was noted that the organic matter content of soils under shade was 20 per cent. higher than in those without shade.

The effect of shade trees on the composition of the tea leaf was also examined. For samples taken at Swazi Tea Station, the results were as follows:—

	Per cent. Nitrogen in tea leaf	
	January	*February*
No shade	3.8	2.7
No shade+Nitrogen	4.3	3.3
Albizzia shade	4.5	3.3
Albizzia+Nitrogen	4.2	3.4

On the other estates the results were not definite, possibly due to irregular deposition of leaf by the wind.

Analysis of nitrogen content leaves from shade trees showed the superiority of *Albizzia;* but further tests will be made to confirm this.

	Grevilla (fallen)	*Albizzia (on tree)*	*Albizzia (fallen)*
Per cent. Nitrogen	0.9 ..	3.4 ..	1.5

These figures must be considered in conjunction with the amount of leaf fall, as *Grevilla* gives a heavier mulch than does *Albizzia*.

Tung

(*a*) One hundred and forty samples of leaves from fertilizer experiments on estates and the Bvumbwe Station have been analysed to see if any optimum levels can be fixed, the experiments including the copper and zinc trials. A full examination of

the results has not yet been possible, but it appears that the analysis of the leaves generally reflects the avaliable nutrient status of the soil, as indicated in the following table.

	Soils analysis			*Average weight*	*Leaf analysis*		
	N	*P*	*K*		*N*	*P*	*K*
	%	%	%	%	%	%	%
Experiment 1	0.08	.001	0.043	1.4	1.5	0.22	1.2
Experiment 2	0.15	.005	0.024	1.9	2.1	0.40	1.0

It should be noted that the experiment on the soil of lower fertility has only been in operation for a few years and a more pronounced effect of fertilizer addition may be apparent in the future.

(*b*) Two estates, one in the north of the territory and one in the south, reported premature leaf fall and dieback of tung in some of their areas.

On the estate in the north, the following figures showed the cause to be chiefly a lack of the main nutirents.

	"A" type tree				*"B" type tree*			
	weight of leaf grms.	*per cent*			*weight of leaf grms.*	*per cent*		
		N	*P*	*K*		*N*	*P*	*K*
Good	3.1	2.8	0.4	1.4	3.2	2.9	0.5	1.5
Poor	2.2	1.4	0.2	0.8	2.6	1.1	0.1	0.5

These figures raise the question whether the more precocious " B " type trees are depleting the soil of potash supplies which have been indicated as lower than in the soils of the Southern Province. It should also be reported that other leaves from the " B " type trees did not show uniformly a low content of potash. More information is necessary on this problem and will be obtained in the coming season.

On the estate in the Southern Province, premature leaf fall was associated with malformation of the branches giving a " witch's broom " effect. Leaf analysis showed that leaves from affected areas had a similar composition to those from a more normal field, except that the nitrogen content was rather lower (1.5 per cent. against 1.8 per cent.). The occurrence of this disease is rather irregular in any field in which it is found. This suggests that it may be a " drought " phenomenon, the location of its appearance being governed by local variations in the morphology of the soils, in the same way as the zinc and copper deficiencies were found in 1950 after the drought of 1949. It is also of some significance that this malformation had been reported by the Plant Pathologist on the same estate in 1950. Pits are being prepared for a closer examination of the soils in the affected and good areas.

5. Pastures

(*a*) *Cattle Emaciation disease and pasture work*

The Veterinary Research Officer had found that Tung Station cattle had a very low phosphate content in the blood, much lower than the 5 p.p.m. considered as a minimum. Grass from the grazing area was analysed for total and water soluble (hot and cold)—Ca and P. Well-grown Cynodon grass from the experimental plot near the laboratory was also analysed, as was grass from the nearby Chingaluwe Estate, where the same disease was apparent but not so deadly as at the Tung Station.

Analysis of soils from the two Tung Station areas were also made, and are given for comparison of the uptake of the grasses.

Analysis of Grasses

Per cent. of dry material

Moisture	*Ash*	*Ca*	*P*	*K*	*Water soluble P*	*Protein*	*Fibre*	*Oil*	*Soluble carbohydrate*
Tung Station Dambo Grazing Area. Sampled October after 1.9 ins. rain									
16	—	0.25	0.19	—	0.025	—	—	—	
Tung Station Dambo Grazing Area. Sampled November after 3.7 ins. more rain									
20	17.2	0.27	0.18	0.05	0.048	3.9	29	2.3	47.2
Tung Station– Cynodon No. 2. Trial Plots, Sampled October									
—	—	—	0.59	—	0.095	—	—	—	
Tung Station Cynodon No. 2. Trial Sampled, November									
31	9.9	0.39	0.50	—	0.10	—	—	—	-
Tung Station—Rhodes Grass—Road Field sampled March									
11	11.6	0.49	0.47	1.2	0.29	9.4	28	1.5	49.5
Chingaluwe Estate—Sampled November									
8	9.5	0.26	0.22	—	0.044	—	—	-	-
Zombwe Area Grass—Sampled December									
10	15.4	0.23	0.22	—	0.10	4.5	29	1.6	51.0

Analysis of Soils from Tung Station Grazing Areas

pH	*Texture*				*Org. C.*	*K m.e. 100 grm.*	*Available P. p.p.m.*	*N per cent.*	*C/N*	*Base cap.*	*Ex H.*	*Total bases*	*Saturation per cent.*
	C.S.	*F.S.*	*Clay*	*St.*									
Tung Station Dambo													
5.7	68	24	6	4	0.9	0.13	10	0.06	15.0	6.1	2.5	3.5	58
Tung Station—Road Field—Rhodes Grass													
6.0	38	31	15	13	2.1	0.84	56	0.13	16.1	12.6	3.3	8.3	68

Points of interest to note about these figures are:—

1. The low water-soluble Phosphate content of the Tung Station *Dambo* grass, compared with the Zombwe grass, the Rhodes grass, or the Cynodon. An increase with the rains may be noticed, and as some rain had fallen before the first sample was taken, it is clear that at the height of the dry-season, water-soluble phosphate would be 0.025 per cent.

2. The Ca/P ration in the *Dambo* grass although not at the maximum of 2/1 which is considered permissible, is still however higher than in the other grasses.

(3) The protein content of the *dambo* grass is lower than the Rhodes grass—but only slightly lower than in the grass from Zombwe.

Although the Ca/P ratio on the tung grazing area was rather higher than elsewhere. the main correlation was in the cold water soluble phosphate of the grass Various extraction methods were used, as no macerator was available, and although different figures were obtained by the various procedures, the order of concentration was always the same. *Viz.*—Cynodon (the highest), Chingaluwe, Tung Station. This correlation with blood phosphate content would suggest that phosphate deficiency or imbalance was causing the deterioration. In late November, when the Veterinary Research Officer reported an increased and normal content of phosphate in the blood of the Tung Station cattle, analysis of the grass growing at this time showed no appreciable change in the total P and Ca. However, the water soluble P in the Tung Station grass had increased by approximately 50 per cent.

This would suggest that P. was the main element to follow; but recently, in spite of the feeding of water soluble phosphate to the cattle, the Veterinary Officer is not satisfied that improvement is appreciable. This may indicate that a further element essential for satisfactory metabolism is not adequately supplied. But the time required to overcome continued shortage of P. must be considered, and the effect of increased water soluble phosphate dosages—although becoming quickly apparent in the blood—would not be so rapidly shown in the general condition of the cattle.

It is clear therefore that not any one factor is particularly outstanding as causing the poor grazing at the tung station—although the shortage of water soluble phosphate is certainly the most consistent figure. Unfortunately, time has so far not permitted of further minor element study in this connection.

(*b*) On the Rhodes grass field at the Bvumbwe Station a superior growth of grass was again found in some places. Analysis of soils and grasses indicated the higher nitrogen and organic matter content of these sites, which correspond with old hut sites, the grass of roofs greatly contributing to the fertility and moisture retention of the soils.

Copper and Zinc: Chilwa rice samples gave figures of 15 and 24 p.p.m. copper and 27 and 41 p.p.m. zinc in the chlorotic and green leaves respectively.

Boron: The Boron content of the Sombani River was found to be 0.5 p.p.m., which in this respect proved it suitable for irrigation of the rice on the Chilwa Plain.

Molybdenum: In the investigation of tung dieback, already referred to, the molybdenum content of the leaves from " A " and " B " type trees were determined. The " A " type (bad and good) contained 0.1 p.p.m., while the " B " type leaves showed no Mo content.

D. General Section

Irrigation Projects

Water from the River Sombani was found suitable for irrigation of rice on the Chilwa Project. The composition is shown below:—

pH.	7°2
Conductivity at 25°C (millimnos)	0.08
Salt concentration p.p. 100,000	4.2
Calcium p.p. 100,000	0.48
Magnesium	0.19
Potassium	0.98
Chloride	1.1
Sulphate	0.2
Carbonate	Nil
Bicarbonate	8.4
Boron	0.5

(*a*) Fertilizer

Guano from islands on Lake Nyasa was found to have the following composition:

	Per cent.
Organic matter	18
Phosphates (total P_2O_5)	21
Lime (Cao)	25
Potash (K_2o)	1
Nitrogen	2

(*b*) Miscellaneous

(*a*) Samples of tobacco extract and tobacco leaf were examined for nicotine content. The leaf was found to contain 3.2 per cent. nicotine and the leaf and stalk 2.2 per cent.

(*b*) Four samples of Nyasaland maize were analysed following reports from Rhodesia that the Flint types were of high fibre content. The following results show that this was not confirmed.

	Nyasaland maize			*Southern Rhodesia hybrid*	*Southern Rhodesia maize*		
	Chitala	*Namalenga*	*Makanga*		*Dents*	*Flints*	*Unspecified*
Moisture ..	11.5	11.8	10.4	11.4	7.0	7.4	11.0
Analysis of Dry Material							
Crude protein	10.1	9.9	10.1	8.6	10.1	11.8	10.1
Soluble carbohydrates ..	82.0	82.0	81.6	82.3	81.6	78.6	83.8
Fibre ..	1.3	1.4	1.8	1.8	2.0	2.0	1.9
Oil and fatty material ..	4.9	5.0	5.5	5.0	4.9	5.7	2.8
Ash ..	1.5	1.7	1.3	1.8	1.4	1.9	1.4

ENTOMOLOGIST'S REPORT

General Pests

1. The Acridiid *Cataloipus cognatus* Wlk. was found in loose swarms in the Central Shire. This species, regarded by the local people as a delicacy, was incorporated into the diet before it was able to do appreciable harm. The Coccinellid *Epilachna dregei* Muls. was recorded as a defoliator of potatoes in the Northern Province.

2. *Locusts:* No locusts were reported from anywhere in the Protectorate.

3. *Army Worm:* First reports of army worm attack were received from the Fort Johnston area during the third week of December. This infestation appeared to die out following heavy rain and nothing further was heard of it. Early in January the situation in the Zomba area gave rise to some alarm; the attack occurred in a wide band from the Domasi to the Chiradzulu areas. There were also reports from Mlanje and from parts of the Lower River. Maize bore almost the whole attack but there was one instance where an insignificant amount of feeding occurred on tobacco, following the destruction of grass weeds on which the caterpillars had been feeding.

Various control measures were adopted. In the Domasi District an organized campaign of D.D.T. and B.H.C. spraying and dusting killed large numbers of the insects. Where labour was available hand-picking and trampling was resorted to and some farmers used oil, such as Diesel fuel, to kill the caterpillars in grass strips adjoining maize fields.

The attack died out towards the end of January and no second generation occurred.

4. *Elegant Grasshopper:* It was hoped, in the season under review, that field trials in the control of *Zonoceras elegans* Thumb. could be undertaken in the Lower River. Some small scale preliminary work at the Makanga Station was not promising. Heavy dusting with B.H.C. did not have any appreciable effect on third stage hoppers in grass. In cage trials second, third and fourth stage hoppers were killed by B.H.C. carried on banana pulp but could not be attracted to the same bait in the field. Hoppers would not feed on a bait prepared from B.H.C. and chopped sugar cane.

In the Makanga area attacks on cotton were not considered serious enough for spray trials; the concluding part of the work was carried out in the Chikwawa District. A bait prepared from B.H.C. and maize bran moistened with molasses was applied moist in a cotton garden, containing large numbers of third and fourth stage hoppers. The bait had no attraction for the insects.

A further trial, using toxaphene spray, was carried out. This also was ineffective. At this point work for the season had to be suspended but further work is planned for next season.

Crop Pests

1. *Cereals:* The Dynastid *Heteronychus mosambicus* Per. damaged maize in the Chiradzulu District but the attack, as with others in the past, was very local. Maize stalkborer was more plentiful than last year but was not serious. The Meloid *Epicauta velata* Gerst. was taken from rice at Sombani but serious defoliation was avoided by prompt spraying with B.H.C. *Sesamia epunctifera Humps. Noctuidae* bored in the stems of both rice and wheat and a *Hydrellia* sp. (*Diptera Ephydridae*) was also found boring in rice.

2. *Citrus:* An estate in the Cholo area reported serious russetting of citrus fruit and a visit was made to determine the cause; no insect or mite could be found although the damage resembled that caused by mites. An observational spray trial

using copper and sulphur compounds, was laid down and subsequent visits made to the orchard. In the course of these visits the mite *Brevipalpus australis* was taken; this is regarded by some authorities as a pest of citrus. The observation trial indicated that sulphur, as a dust or as lime-sulphur, was effecting control and recommendations to this effect were passed on to the planter concerned. It is too soon to report on the effect of field scale applications of sulphur.

3. *Coconuts:* For the past two years coconut seedlings in the Fort Johnston area have been subject to a disease condition resulting in the death of many seedlings after transplanting from the nursery. At any time after one month, following planting out, the coconut seedlings begin to show yellowing of the older leaves which later turn brown. The yellowing progresses to the inner leaves and by the time the outer leaf has completely dried the inner shoot may easily be pulled out. Its end is rotten and infested with eelworm. The interior of the nut is reduced to a putrid yellow slime.

The planting area is composed of two types of soils: a coarse dark sand of low fertility overlying a yellow alluvial deposit; and a heavy alluvium of high fertility. Both types had been cleared of a flourishing stand of *Hyphaenae* palms. The distribution of affected seedlings is haphazard over both soil types. The eelworms associated with the rotten stems are not plant parasitic kinds, but the soil around affected plants has never been thoroughly examined. No insects were found associated with the condition and although the possibility of eelworm cannot definitely be excluded it seems likely that a fungus or a bacterium is the cause of the trouble.

4. *Cotton:* The situation with respect to the major pests of this crop remains substantially unchanged from last year. The early cropping regime continues to exercise a check on the red bollworm in the Lower River but in the higher altitudes of the Palombe Plain and the Salima Lake-shore it is evident that the system does not operate with the same efficiency. In these areas red bollworm may be regarded as the limiting factor to increased cotton production. The attack on the whole is earlier by six weeks than in the Lower River and much of the early crop was lost.

In an investigation of bollworm attack in the Balaka area it was demonstrated that the American bollworm *Heliothis armigera* Hubn. was causing considerable damage. This was in contrast to the conditions in African-grown cotton in the same district, where red bollworm was the dominant pest and it is considered to be due to the practice, on the farms visited, of growing large blocks of maize in proximity to cotton.

Stainers (*Dysdercus* spp.) were again numerous, *Nematospora* staining being particularly bad at Makanga. A small amount of jassid damage was seen but in most cases it appeared to be correlated with poor soil conditions. The Acridiid *Phymateus viridipes* St. did minor damage in one locality.

On the North Nyasa Lake-shore young cotton suffered some damage from the molecricket *Gryllotalpa africana* Pal. B. but the main pest in the region this season has been rats, which in many cases have reduced the yield by 50 per cent.

5. *Pulses:* At the Tuchila Experimental Station insecticide trials against the Galerucid *Ootheca mutabilis* Sahlb. were carried out. Materials tested were D.D.T., B.H.C., Chlordane, Aldrin and Dieldrin. Of these Dieldrin as a wettable powder was practically 100 per cent. effective and persisted for a period of three weeks. The persistence of Aldrin was scarcely a third of that for Dieldrin. D.D.T. wettable powder was the least effective of all materials used.

Beanfly, *Agromyza soyae* Zehnt, and stemweevil *Alcides leucogrammus* Er. caused considerable damage to beans in the Central Province.

6. *Shade Trees, Forestry, etc.* A small bagworm was reported from Mwera Hill causing damage to pine seedlings lined out and in the nurseries. The case is composed of $^1/_{10}$ ins. lengths of pine needles and grass stems. No identification has so far been possible.

In the Lilongwe area there have been two serious local outbreaks of tree pests. On one estate, plantations of *Cassia siamea* have been heavily attacked by a borer which appears to be the larva of a Cossid moth, although no adults have yet been obtained. Fully grown larvae are $\frac{1}{4}$ to $\frac{1}{2}$ in. long, grub-like in form and pale pink in colour. Small borers may girdle the stem under the bark, then enter woody tissue and migrate downward to the lower stem near ground level. However, many appear to enter the wood directly after hatching from the egg. Trees growing in large blocks of pure stand are worst affected; isolated trees on similar soil, short distances from a heavily infested block, were only lightly attacked.

Near Lilongwe itself a small pure stand of Persian lilac (*Melia azedarach L.*) was attached by the Bostrychid *Apate indistincta* Murray. Boring was found over the whole length of the stem, the tunnels being up to $\frac{3}{8}$ inch. in diameter. The entire stand was cut out.

The Coccid *Aspidiotus sylvaticus* Ldgr. was taken from *Albizzia procera* at Mlanje and the giant coccid *Aspidoproctus pertinax* Newst. heavily infested some *Cassia* at Domasi.

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The Entomologist is indebted to Mr. G. C. Martin of the Rhodesia Tobacco Association for examination of nematode material, to Dr. R. F. Lawrence for identification the mite *Brevipalpus* and to the field staff of the Department for sending specimens and helping with tours.

COTTON EXPERIMENT STATION—CHITALA

Progress Report for the Season 1953/54

Introductory Note

Nyasaland experienced a shortfall in rain for the second year in succession, and the water supply situation in some areas is critical at the time of writing this Report. Fortunately, the Experiment Station is served by two deep bore-holes, the supply from which seems unfailing. The Lower River cotton areas were the worst affected by drought conditions, though where distribution was good the crop did not suffer unduly. The Central Areas were more fortunate, particularly in their planting rains which were early and sufficient for good germination. Rainfall at the Cotton Experiment Station was as follows:—

Inches

1953		1954									
Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
–	1.76	8.71	8.23	6.16	1.10	0.15	–	–	–	–	0.80

The total for the growing season, of 26.11 ins., was about 8 ins. below the 20-year average, but this year good sowing rains at the end of November and in early December made the season very different to that of 1952/53. The fall of 0.8 ins. in September is exceptional; only three times previously has rain been recorded at Chitala during this month, and it is of interest to note that each time a good cotton year has followed.

Good yields were obtained with maize, fair yields with sorghum, and very good yields with groundnuts, but cotton suffered severely from bollworm damage. Even so, with the better start to the season yields were double those of 1952/53 at this station and some quite large returns were recorded in Dowa District, which produced 571 tons of seed cotton with a mean yield of 338 lbs. of seed cotton per acre, compared with 347 tons at 248 lbs. per acre last year. The C.L.20 multiplication areas at the Nyasaland Farming Corporation, Balaka, farms did well, averaging 613 lb. seed cotton per acre 220 acres. But owing to the drought conditions a crop of about 10,000 bales lint is all that can be expected from the country as a whole.

The Egyptian cotton trial, repeated at Karonga, gave rather better returns than in 1952/53, but it has been decided that Egyptian types in their present guise cannot compete in yield with Uplands. Results were as under:—

Table I
Yields in lb. Seed Cotton per acre

Variety	*Karonga*	*Type*
BAR 4/16	556 ..	Egyptian
B.L.R. 14/25	789 ..	,,
X1730A	659 ..	,,
Domains Sakel	780 ..	,,
XL1	583 ..	,,
SUS 16/1 (Wilds)	923 ..	Upland
B.P.52 (Namulonge)	1,259 ..	,,
C.L.B. Karonga	1,300 ..	,, Local (Control)
S.E.	44	

A further trial, planted in May, 1954, is of Upland types only, using Sudan and East African long staples material with C.L.B. Karonga and C.L.20 as controls. It is reported to be doing well, but yield figures will not be available till January, 1955.

Mechanization

Further experiments with the tractor disc-ridger have given good results, and a set-up suggested by Mr. A. L. Stephens of Namulonge bids fair to solve our problem of how to obtain even and regularly spaced rows. This set-up enables the tractor to construct two full ridges and two half ridges at one time.

A new type of disc cultivator will shortly be under trial, which it is hoped may improve land preparation and economize ploughing. The importance of the " human factor " in efficient power cultivation can hardly be over-stressed.

Cotton

Varietal trials, comparing local and leading East African varieties, were discontinued and replaced with trials between locally bred strains now in bulk. These were combined with further tests of " Perenox " bactericide and repeated at the Tuchila Station in the South-east section of the Central areas and at three sites in the Lower River. Results were as follows:—

Table II

Yields in lb. Seed Cotton per acre

Variety	*Chitala*	*Tuchila*	*Kakoma*	*Ngabu*	*Makanga*	*Means*
		Plain ginned seed				
C.L.B.	519	1,084	674	862	913	810
C.L.B. Filter	475	912	692	896	775	750
C.L.20	601	1,100	636	1,002	785	825
C.L.20 Filter	624	1,146	632	952	734	818
		Seed dusted with Perenox				
C.L.B.	503	1,117	691	801	897	802
C.L.B. Filter	519	1,135	669	985	863	834
C.L.20	632	1,299	747	1,002	804	897
C.L.20 Filter	596	1,207	749	885	795	846
S.E.	13	36	29	31	31	—

The high yields obtained at Tuchila are noteworthy and compare well with those of 1952/53. C.L.20 has again done well, especially when its seed was dusted with Perenox before sowing, while C.L.B. is obviously still a valuable stock. The two " filter " bulks, which were mechanical mixtures of the leading sub-strains of each local stock, did not surpass their parents.

The Perenox effects are dealt with more fully under " Bacterial Blight " below, but it may be mentioned in passing that C.L.20 appears to be more susceptible to the disease than its parent C.L.B. During the past three years a shortfall, in ginning out-turn of cotton grown in the Lower River, has been observed. This drop was first noticed in 1951 when early up-rooting to control Red Bollworm was first enforced, and has continued in varying degrees under the new regime. All varieties so far tested are affected, and there is evidence of seasonal fluctuations. The matter came to a head in 1954, when commercial saw ginnings of C.L.B. had only averaged 28.13 per cent. G.O.T. up to July 31st.

Replicated roller ginnings were made from samples of the seed cotton from the variety trials listed in Table II above, and the following results were obtained:—

TABLE III

Variety	Chitala	Tuchila	Kakoma	Ngabu	Makanga
		Per cent. G.O.T.			
C.L.B. ..	32.7	32.0 ..	28.6 ..	29.4 ..	32.0
C.L.B. Filter ..	33.7	32.2 ..	29.4 ..	30.0 ..	33.1
C.L.20 ..	32.8	31.5 ..	29.3 ..	30.2 ..	32.0
C.L.20, Filter ..	32.9	32.2 ..	29.1 ..	29.8 ..	33.0
Means ..	33.0	31.9 ..	29.1 ..	29.8 ..	32.5
		Wt. 100 seeds, grams			
C.L.B. ..	8.9	9.8 ..	9.7 ..	9.3 ..	8.1
C.L.B. Filter ..	8.7	9.7 ..	9.7 ..	9.3 ..	8.0
C.L.20 ..	9.5	10.4 ..	9.7 ..	9.4 ..	8.2
C.L.20, Filter ..	9.6	10.4 ..	9.9 ..	9.7 ..	7.9
Means ..	9.2	10.1 ..	9.7 ..	9.4 ..	8.0
		Lint Indices, grams			
C.L.B. ..	4.3	4.6 ..	3.9 ..	3.8 ..	3.7
C.L.B. Filter ..	4.4	4.7 ..	4.1 ..	4.0 ..	4.0
C.L.20 ..	4.6	4.8 ..	4.1 ..	4.1 ..	3.8
C.L.20 Filter ..	4.7	4.9 ..	4.1 ..	4.1 ..	3.9
Means ..	4.5	4.7 ..	4.1 ..	4.0 ..	3.8

Low seed weights at Makanga made the G.O.T. at that place an exception to the general rule in the Lower River.

A large number of samples were drawn from the commercial C.L.B. crop of both the Central Areas and the Lower River. Their seed cotton characters were measured and the same roller gin was used as for the variety trials. Mean results were as follows:—

TABLE IV

	G.O.T. per cent.	*Weight 100 seeds, grams*	*Lint Index grams*
Central areas	31.8 ..	8.7 ..	4.1
Lower River	28.7 ..	9.0 ..	3.6

It would appear that the new regime in the Lower River has resulted in slightly increased seed weights and considerably lessened lint indices, giving rise to a lowered G.O.T.

Examination of past records shows that there has been little or no genetic change in C.L.B. over the past 16 years, but that the new regime has resulted in a marked improvement in spinning quality. Maturity values have been well maintained and the conclusion therefore is that lint of increased fineness and strength is being produced. This is borne out by comparisons between 14 strains of C.L.20 grown both at Chitala and at Makanga in 1952/53 and examined by the B.C.I.R.A., Shirley Institute. Their means for lint values are as follows:—

TABLE V

G.L.20 Variety	*G.O.T. per cent*	*Mean fibre weight*	*Standard fibre weight*	*At 40's count × strength product*	*Yarn appearance*
Chitala	32.9 (117)	158 (113)	182 (114)	2,174	3.6
Makanga ..	28.0 (100)	139 (100)	159 (100)	2,492	3.7

The ratios given in ( ) are with Makanga = 100.

It will be seen that much of the G.O.T. difference can be accounted for by the fibre weight difference; slightly increased seed weight at Makanga would complete the picture, but, unfortunately, there are no records of seed weights for the 1952/53 material.

Ginning out-turn is an important commercial consideration, and a solution is being sought to the Lower River shortfall. Possibilities lie in reselection under Lower River conditions from existing stocks, and the use of high ginning Albar 51 derivatives, among other measures. Suitable trials and arrangements are being planned for 1954/55 to be operated at Makanga and Ngabu.

Bacterial Blight

In addition to the experiments listed in Table II above, a trial to compare directly the effects of " Perenox " and " Perecot," using undressed seed as a control, was laid down at the Cotton Experimental Station, Chitala. It was realized, when these experiments were planned, that orthodox trials had been invalidated elsewhere by secondary infections among the growing crop, but it was believed from past observations that under Nyasaland conditions some useful results might be obtained, since the boll phase of bacterial blight is relatively uncommon, in most years and on most sites. Counts of infection were made on a total plant basis with the following results:—

Table VI

Variety C.L.20	*Angular leaf spot phase counts at 4th true leaf infected per cent.*	*Blackarm phase at first flower infected per cent.*	*Yield lb. seed cotton per acre*
Bulk control Untreated seed	26.6	10.6	376
Perenox dusted	7.8	4.6	384
Perecot dusted	4.9	2.5	382
S.E.	1.15	0.50	Not. Sig.

The treatment was 1 lb. Perenox (or Perecot) per lb. ginned fully fuzzed seed, applied as a dry dust three weeks before planting. Similar observations were made on the cotton variety cum Perenox dusting trial (*see* Table II above) with results as summarized below:—

Table VII

Variety C.L. 20	*Angular leaf spot phase counts at 4th true leaf infected per cent*	*Blackarm phase at first flower infected per cent*	*Yield lb. seed cotton per acre*
Variety untreated			
C.L.B.	23.6	7.0	519
C.L.B. Filter	22.6	10.2	475
C.L. 20	30.5	7.1	601
C.L.20 Filter	30.4	8.3	624
Seed dusted with perenox			
C.L.B.	16.3	6.1	503
C.L.B. Filter	13.8	6.1	519
C.L.20	20.0	5.1	632
C.L.20 Filter	19.4	8.3	596
S.E.	2.50	0.50	13

The treatment was exactly similar to that used for the previous trial (Table VI) and the C.L.20 seed stock was also identical.

One major difference between the two experiments was that the Perenox-Perecot trial was planted on land which had been resting under bush fallow for five years. The variety cum Perenox trial on the other hand was on land which had carried cotton two years previously. The heavier incidence of Bacterial Blight in the latter on C.L.20 may be due to field infection.

The above figures of yield are from Table II, in which further comparisons may be made. The extra susceptibility of C.L.20 to the disease, compared with its parent C.L.B., has already been noted. The full analysis is not given in the tables, but at Chitala seed dressing was not significant in its effect on yields while at Tuchila both dressing effect and interaction between seed dressing and variety were significant. For the Lower River experiments, results at Kakoma were the same as those of Tuchila for C.L.20 but not for C.L.B. At Ngabu, which had a very dry year, seed dressing had no significant effect on yield and at Makanga the result was the same.

Seed disinfection by a bactericide is obviously beneficial in Nyasaland under certain circumstances, and it seems to have its major effect on yield by rendering the young plants more healthy. The most noticeable reduction by it was in the angular leaf spot and vein lesion counts on young plants. The blackarm phase was much less common though significant differences were still observable in the trials. The boll phase was distinctly uncommon and could not be recorded satisfactorily from the trials.

To obtain some idea of the incidence of this last phase, random samplings were made in suitable bulk fields at the beginning of harvest, the entire crop being stripped from 50 holes in each case. Results were as under:—

Table VIII

At Harvest—Per cent. Analysis of Total Crop from Plants of 50 Holes

	Bollworm damaged	*Stainer damaged*	*Bacterial blight damaged*	*Sound bolls undamaged*
Chitala ..	50.6	10.9	2.1	36.4
Tuchila ..	21.2	40.9	7.4	30.5
Kakoma ..	40.2	42.9	5.0	11.9
Ngabu ..	25.3	17.1	2.2	55.4
Makanga ..	37.9	46.5	2.8	12.8

The position therefore where bacterial blight is concerned in Nyasaland, was that this past year the angular leaf spot and allied phases were frequent, the blackarm phase less so, and the boll phase relatively uncommon. There seems to be an indication that the health of young plants is important in determining final seed cotton yields, and for this reason seed treatment is to be recommended. Other years, with heavier rainfall, may result in greater infection and more emphasis on the later stages of the disease. Seed treatment may be looked upon as an insurance while susceptible or partly susceptible varieties are being cultivated, and the introduction of truly resistant varieties may obviate the need for its use, Albar 51 stocks grown in observation at Chitala have shown considerable promise, and there is some good material in the Albar 49 crosses, though some heavy rogueing of Jassid susceptible plants has been necessary. It is proposed to put a number of these stocks into variety trials at Chitala, Makanga and Ngabu.

Insect Pests

Red Bollworm, *Diparopsis castanea* Hmps., was again the dominant pest at Chitala, but Tuchila escaped with a relatively light infestation. Quite large populations were observed at Lower River stations in early May, where egg counts made by

the Government Entomologist showed that the main carry-over flight began emerging in late March. It is obvious that there is still plenty of bollworm about, and a very slight slackening in the precautions now taken in the Lower River might have serious after-affects. There must be no relaxation of the early-planting early-uprooting regime, and it is to be hoped that the pest will not adapt itself to present circumstances.

The Lower River is now making a crop before the bollworm attains large numbers, but at Chitala and elsewhere in the Central areas the position remains serious. Here, in spite of July 31st up-rooting, the carry-over from one season to the next remains large, and what is worse, the main moth emergence takes place in January and early February, about two months earlier than is the case in the Lower River. Some more positive means of control is required.

Stainers are at present of more importance than bollworm in parts of the Lower River. It was difficult to find a really sound boll at Makanga in May and, as seen above, the seed cotton suffered in quality and quantity. Ngabu and other areas to the west of the Shire River were less affected, but some late cotton at Kakoma was rather badly damaged. The discrepancy in the G.O.T. figures for Makanga is largely due to Stainer damage.

Husbandry and Rotation Crops

The necessity for earliness with rain-grown cotton has been stressed on many occasions. A series of experiments, comparing four dates of sowing and two levels of weeding in a split-plot layout, gave the following results:—

Table IX

Yields in lb. Seed Cotton per acre

Clean weeded throughout	*Chitala*	*Tuchila*	*Ngabu*	*Makanga*	*Means*
1st Sowing ..	244 ..	1,239 ..	732 ..	1,005 ..	805
2nd „ ..	194 ..	1,017 ..	638 ..	976 ..	706
3rd „ ..	157 ..	609 ..	618 ..	704 ..	519
4th „ ..	34 ..	— ..	— ..	89 ..	61
Weeding delayed ten days, thereafter clean weeding					
1st Sowing ..	204 ..	919 ..	708 ..	974 ..	701
2nd „ ..	189 ..	523 ..	524 ..	816 ..	514
3rd „ ..	91 ..	410 ..	506 ..	550 ..	389
4th „ ..	19 ..	— ..	— ..	82 ..	50
S.E. Sowings ..	9.3 ..	45.7 ..	51.3 ..	58.6 ..	—
S.E. Weedings ..	9.6 ..	41.6 ..	47.2 ..	45.2 ..	—

These results are strikingly clear and it is noticeable that even so small a delay as ten days in weeding had a markedly significant effect. The sowing dates were 1st–21–11–53 (Chitala) (30–11–53); 2nd–7–12–53; 3rd–21–12–53 and 4th–6–1–54. There was no significant interaction between sowing date and weeding delay.

Manurial trials, to test further the effect of sulphate of ammonia, were done with cotton at Chitala and Makanga.

Three rates of nitrogen at three timings were used but there were no significant differences between the final yields at either stations. Nitrogen was evidently sufficient from natural sources in so dry a season.

As in previous years, experiments with rotation crops were linked with general trials, conducted by the Department of Agriculture They were confined this year to a maize manuring trial with nitrogen at various levels and at differing timings, and to a groundnut variety trial, using the best 25 varieties from last year. Results were good, especially with groundnuts which produced well over one ton of nuts in shell per acre The full figures will be published elsewhere with those of the Departmental trials.

Sorghum is a successful crop at Chitala and a Sudan variety, called Karinaka was sown in large bulk on land due for rest. The crop was left unweeded and untocked till harvest. Seed stocks of this variety, which has a bold white grain and is attractive to the African, have been supplied to the Department of Agriculture for issue in the Chikwawa District. Well-treated Karinaka yields nearly 2,000 lb. grain per acre but harshly served, as it was at Chitala this year, the crop only averaged 600 lb. per acre.

All land not in use as arable is now under bush fallow and is being grazed by the cattle herd. Some 30 acres were mown to help provide dry season feed. Tree growth is a nuisance but not too expensive to deal with by hand if not allowed to become too large. The same applies to *termitaria* which spring up at a great rate. No serious attempt has yet been made at artificial establishment of grasses other than Elephant grass, but observation strips were broadcast with Rhodes grass, *Chloris gayana*, this past season. For the most part the cattle seem well satisfied with a local grass, *Urochloa mossambicensis*, which self-seeds generously, is perennial but easily ploughed out, and is of high food value.

The herd has more than doubled in numbers since it arrived in May last year. Ten calves were produced by nine cows as a first crop, and five have so far been born in the second crop of calves now arriving. One, unfortunately, had a deformed foot and had to be killed. Tsetse fly continues to remain absent, and there are very few ticks.

Experimental Work

The results set out below refer to the crop season July, 1953, to June, 1954, unless otherwise stated. The season was about 10 ins. of rain below average and the crop was accordingly low. Except for one or two short periods labour was adequate and no experiment suffered through labour shortages.

The experimental programme is up to date.

Nursery Experiments

(i) *Manurial Experiment, Swazi:*

This experiment, planted in 1951 and first mentioned in last year's Report compared the following treatments:

N0, No sulphate of ammonia and N1. 1 oz. of sulphate of ammonia per sq. yd. of nursery bed.

P0, No superphosphate and P1. 1 oz. superphosphate per sq. yd.

K0, No muriate of potash and K1. 1 oz. of muriate of potash per sq. yd.

D0, No dung and D1, 5 lb. dung per sq. yd. of nursery.

B0, Seed germinated in pits and then transplanted to nursery beds and B1. seed planted directly into beds.

The initial application of these treatments during the first six months after planting caused no significant differences in mean girths of seedlings at 4 ins. above ground level when the plants were 18 months old.

The fertilizer and dung treatments were reapplied in January, 1953, and girth measurements were repeated the following November at 31 months after the experiment first started. Seedlings germinated in sand pits, prior to planting in nursery beds, resulted in significantly larger seedlings at P 0.05; there being no other significant differences at P 0.05, although the effect due to sulphate of ammonia was considerably greater than any of the other fertilizer treatments and was significant between P 0.02 and P 0.05.

This experiment was transferred to the field at Mimosa and will be used to compare the effects of the three standard fertilizers on young tea, from planting to maturity.

(ii) *Effects of a Fertilizer Mixture, Mimosa:*

It was recorded in last year's Report that an application to nursery beds at Mimosa of 1 oz. per sq. yd. of a fertilizer mixture containing 6 per cent. N. 10 per cent. P. 8 per cent. K. had resulted in a significant increase in seedling stem diameter at P 0.05.

In repetition of last year's work all stumps planted in the second yearly replications of the establishment experiments and grown in Mimosa nurseries, had their diameters measured at 4 ins. above ground level immediately after planting out. Last year's result was repeated and the increase in mean diameter, due to a similar dressing of fertilizer, was significant this season at P 0.01.

Establishment of Tea Stumps in the Field

(i) *N.P.K. Fertilizer Experiment on Young Tea, Mimosa:*

The Swazi fertilizer experiment, described above, was transferred to the field at Mimosa during December, 1953. Seedlings from germinating pits and direct planting to nursery beds, being bulked together leaving thereby four treatments; N.P.K. being retained and the dung treatment being replaced by a blank treatment for future use as required.

No fertilizer was applied during the first six months in the field and mortality counts were taken at the end of that period. No significant differences in survival resulted from nursery treatment.

(ii) *Establishment Experiments, Mimosa, and Tung Station, Cholo:*

The first of the series of these experiments completed their cycle and the second seasonal replications were planted in December, 1953, at Mimosa and at the Tung Station.

1952/1953 *Replications:*

Rainfall for the year January, 1953, to December, 1953, totalled 59.97 ins. at Mimos and at the Tung Station 58.43 ins. against the ten year average of 75.03 and 51.90 ins. respectively.

These experiments comprise two whole replications at each site of a two to the fifth design involving the following main treatments:—

(*a*) 18 month old stumps against 30 month old stumps.

(*b*) No nursery fertilizer against 2 oz. fertilizer (Compound A:6.:10:8) mixture per sq. yd. of nursery bed.

(*c*) Stumps shaded with collar pots against stumps shaded with fish bean *Tephrosia* sp.

(*d*) No starter fertilizer against 1 oz. fertilizer mixture applied adjacent to the stump immediately after planting.

(*e*) A 4 ins. tall stamp against an 8 ins. tall stump.

Mortality counts were taken in December, 1953, about 12 months after planting, and because there were differences in effects between locations, recounts were made but resulted in no change in the first results recorded in Table I.

Table I: Percentage of Deaths Twelve Months after Planting Out, of the Number of Stumps Originally Planted

	Age (*a*)		*Nursery Fertilizer* (*b*)		*Shade* (*c*)		*Starter Fertilizer* (*d*)		*Length of Stump* (*e*)	
	18 m.	30 m.	—	+	*pots*	*teph.*	—	+	4 *ins.*	8 *ins.*
Mimosa ..	13.6	12.0	15.5	10.1	10.8	14.8	14.0	11.6	11.2	14.4
Tung Station ..	24.7	13.9	19.4	19.4	15.5	23.1	20.8	17.8	21.0	17.6
L.S.D.	Mimosa		P0.05=3.2,		P0.01=2.3					
	Tung Station		P0.05=4.2,		P0.01=5.7					

Averaged overall treatments 12.8 per cent. deaths occurred at Mimosa and 19.3 at the Tung Station. These percentages are higher than in usual practice at the Tea Stations because no selection for size of stump was made in the nursery bed at uprooting time. As will be seen in more detail below, size of stump has an important and systematic effect upon survival.

No significant differences resulted from age of stump at Mimosa but at the Tung Station the older stumps resulted in significantly less deaths.

Nursery fertilizer, whilst having no effect at the Tung Station, has significantly reduced the number of deaths at Mimosa.

At both locations *Tephrosia* has significantly increased the number of deaths over tea shaded with collar pots.

Starter fertilizer has reduced the number of deaths at both locations but not significantly so. (But for other effects see below.)

At neither location has the length of stump significantly affected the percentage of deaths.

In February, 14 months after planting, some of the Mimosa plots showed severe "yellows," whilst at the Tung Station only few and sporadic plants exhibited symptoms. Of the 32 plots at Mimosa, which had received starter fertilizer 14 months previously, with no subsequent application, none showed any "yellows" symptoms. Twenty-seven of the 32 plots receiving no starter fertilizer showed true "yellows" in decided degree, three to a lesser degree and the two remainder no symptoms. There is thus decided differences between the two locations in the susceptibility of the bush to sulphur deficiency and whilst starter fertilizer had had no significant beneficial effect in reducing deaths up to 12 months after planting it has had a distinct and beneficial persistent effect in overcoming sulphur deficiency at Mimosa. The lack of "yellows" at the Tung Station is in accord with general experience of soil differences between Cholo and Mlanje. At the latter, prevention of yellows by the prophylactic application of fertilizer is essential.

In agreement with previous experience it was noted that new growth of the plant was reduced under *Tephrosia*. In April, 1954, all plants, which had grown taller than a standard ground measure (12 ins.), were pruned and the prunings weighed according to plots. Significant differences were obtained in the growth rate as judged by the number of plants pruned or by the total weight of prunings and these are recorded in Tables II and III.

TABLE II: PERCENTAGE NUMBERS OF PLANTS PRUNED OF ORIGINAL NUMBERS PLANTED

	Age (*a*)		*Nursery Fertilizer* (*b*)		*Shade* (*c*)		*Starter Fertilizer* (*d*)		*Length of Stump* (*e*)	
	18 m.	30 m.	—	+	pots	teph.	—	+	4 ins.	8 ins.
Mimosa ..	80.9	84.9	78.5	87.3	87.4	75.9	75.9	89.9	82.5	83.3
Tung Station ..	45.8	74.5	58.6	61.7	70.3	50.0	56.3	64.0	56.1	64.2
L.S.D.	Mimosa		P0.05=5.5,		P0.01=8.6					
	Tung Station		P0.05=6.3,		P0.01=7.4					

TABLE III: TOTAL WEIGHT OF PRUNINGS OBTAINED IN LB. FRESH WEIGHT

	Age (*a*)		*Nursery Fertilizer* (*b*)		*Shade* (*c*)		*Starter Fertilizer* (*d*)		*Length of Stump* (*e*)	
	18 m.	30 m.	—	×	Pots	teph.	—	+	4 ins.	8 ins.
Mimosa ..	694	938	799	833	1,088	544	604	1,028	827	805
Tung Station ..	100	253	177	176	257	96	139	214	157	196
L.S.D.	Mimosa		P0.05=126,		P0.01=169					
	Tung Station		P0.05= 40,		P0.01= 64					

At Mimosa, at averaged overall treatments, 82.9 per cent. of the number of stumps planted reached pruning height, compared with 60.2 per cent. at the Tung Station. The total weight of growth harvested at Mimosa was 4.6 times that at the Tung Station. The causes of these differences are not exactly explicable from the design of this experiment.

At the Tung Station the older stumps produced significantly more plants ready for prune and at both stations the older stumps produced significantly more growth than the 18 month stumps.

Nursery fertilizer increased significantly the percentage of plants ready for prune at Mimosa but had no significant effect on growth at either location.

At both stations *Tephrosia* significantly reduced the percentage of plants ready for prune and the total weight of prunings.

Starter fertilizer significantly increased the percentages pruned at both stations and the weight of prunings at Mimosa.

At the Tung Station the longer stump significantly increased the numbers of plants pruned but this is not a useful comparison, because the pruning height chosen was 12 ins. above ground level and the longer stumps were consequently nearer this measure purely by physical treatment at the time of planting out.

At Mimosa a significant interaction exists between starter fertilizer (*d*) and shade (*c*) as can be seen from Table IV.

TABLE IV: INTERACTION OF STARTER FERTILIZER AND SHADE

	Weight of prunings in lb. fresh weight		
	Pots	Tephrosia	*L.S.D.*
No starter	389 ..	215 ..	P0.01
Plus starter	699 ..	329 ..	120

Starter fertilizer was proportionately more effective on tea shaded with collar pots than on tea shaded with *Tephrosia*.

Summarizing these results for the first year, which was one of near average rainfall, Differences between treatment effects and between average responses appear between locations and general conditions were more exacting at the Tung Station than at Mimosa.

In no case was the effect of any single treatment reversed between locations and the best results in commerce, both for survival and for subsequent vigour of growth, would have been obtained by using, at both sites 30 month old stumps 4 ins. tall, which had had dressings of nursery fertilizer, shading these with collar pots and by giving a dressing of fertilizer at or shortly after planting time. An 8 ins. stump is not to be preferred because it tends to produce a plant branching too high above ground and leads in the end to a badly shaped mature bush.

The effects of *Tephrosia* have been deleterious and overhead shade of this species cannot be advocated on this year's result or from previous experience. But this does not mean that soil covers as a whole are ruled out. As stated in last year's Report the present problem is one of a search for a suitable species and the correct method of management. To this end the beginnings of a museum of different cover crops has been established at Mimosa.

(iii) *Stem Diameter and Survival:*

A high and highly significant correlation coefficient between stem diameter and root weight of tea stumps was recorded in last year's Report.

All stumps in the survival experiments had their diameters measured immediately after planting and later deaths were plotted against diameter. This data is summarized in Table V.

TABLE V: STEM DIAMETER AND PERCENTAGE DEATHS OF NEWLY PLANTED STUMPS 1952/53 REPLICATION, DEATHS AT 12 MONTHS AFTER PLANTING

	Diameter group in one-sixteenth inches				
	3 to 5	*9 to 8*	*9 to 11*	*12 to 14*	*15 and above*
Mimosa ..	15.3 ..	7.9 ..	4.2 ..	1.4 ..	no plants
Tung Station ..	25.3 ..	14.6 ..	10.6 ..	8.6 ..	0.0
Mean all data ..	19.7 ..	11.6 ..	8.0 ..	5.5 ..	0.0

These values indicate a systematic curve of death and stem diameter and the detailed data is well described by exponential curves.

A study of curves drawn for the individual treatments shows that an exponential function fits well to deaths within each treatment and for each treatment level. The value of 30 month stumps is due to their greater diameters (root weights), and is not a matter of age *per se*.

The practical criterion of selecting stumps by girth measurement (variety and disease excepted) is a sound one. As stated in last year's Report a " pencil thickness is perhaps on the small side and stumps of not less than a little-finger are to be preferred."

(iv) *Root Studies of Newly Planted Stumps:*

These studies, begun last season, were continued at intervals throughout the year. At the beginning of the second dry season, some 18 months after planting, the following notes were recorded. The young root systems were showing signs of differentiating into the morphological pattern obtained by mature plants. From the broken stump end a varying number of roots had penetrated downwards to depths ranging between $2\frac{1}{2}$ ft. to $4\frac{1}{2}$ ft. These roots, from many to two or three per plant, can be regarded as being equivalent to the deeply penetrating tap roots found in mature plants and traced at Swazi down to 15 ft. below soil level. At their extremities the penetrating roots are profusely branched bearing a narrow cone of fibrous roots. The first 12 ins. to 18 ins. of soil is occupied by a branched root system extending radially up to 20 ins. from the stump and these branches bear a mass of fine feeding rootlets. One or more of the bigger branches showed that secondary thickening had occurred and these should develop into the near surface scaffold and storage root system of the mature plant.

A very poor cross section of starch was obtained in the lower part of the stump or in the newly developing storage roots. The root of a stump before planting and when newly removed from the nursery usually has a densely packed and complete cross section of starch, which is presumably used up in producing new growth of roots and shoots after planting.

No quantitative measurements were made on root systems and at 18 months of age the differences in quantities of roots produced by 18 or 30 months old stumps is not as visibly pronounced as it was six months after planting.

The above description applies to an, " average root system " but it must be qualified by saying that no plant had a system exactly like others and that systems varied from those with well-defined storage and penetrating roots to others which bore a mass of fibrous roots with very little differentiation.

Pruning Experiments

(i) *Length of Pruning Cycle and Type of Prune, Swazi:*

This experiment, comparing six different methods of pruning tea, was reviewed in detail in last year's Report, after it had completed 12 consecutive years of treatments.

All plots were pruned at the beginning of this season and for the crop season, clean-pruned plots on two and three-year cycles and cut-across prune on a two-year cycle, outyielded the annual cut-across with centring, (P 0.05). The annual clean-pruned plots just failed by a narrow margin to yield significantly less at P 0.25 than either of the two longer clean-pruned cycles.

(ii) *Pruning Cycles on Local Jat Tea, Thornwood Estate, Mlanje:*

This three-cubed factorial experiment has one set of treatments, comparing the effects of one, two and three-year pruning cycles on local jat; pruning type being a clean-prune.

This, the second season in which treatments were applied saw the annual plots pruned for the second consecutive year and the two and three-year cycles plots carrying bushes in an unpruned state both having been pruned the previous season. The annually pruned plots yielded significantly more than the two longer cycles with unpruned plots as can be seen from Table VI.

Table VI

Yields in lb. m.t.p.a. due to Pruning effects. Thornwood Local Experiment

	Annual cycle pruned	*Two-yearly cycle unpruned*	*Three-yearly cycle unpruned*	*L.S.D. P*0.01
Yield lb. m.t.p.a. ..	1,016 ..	802 ..	838 ..	111

At this early stage in the life of this experiment not too much weight should b placed on the loss of crop, occasioned by extending the pruning cycle. The season was about 10 ins. below average in rainfall and unpruned tea always suffers proportionally more from a shortage of rain. The effects of pruning and any other major treatment, applied to tea can only be considered on a rational basis by examining their cumulative effects over a long period of years. Consistent annual clean-pruning although logical as a prophyllactic measure against poor rainfall, can and does in fact delibilitate the bush. Two cases of starch deficiency have been noted this season caused by too frequent clean-pruning. This is specially true for India jat. Tea is a perennial crop occupying the same site for a long period; the aim of good husbandry is to maintain and increase soil fertility and yield with a minimum of expense over the life of the bush. The achievement of this or otherwise, can only be assessed from results obtained after many years of repeated treatments.

Tipping Experiments

(i) *Height of Tipping Experiment, India Jat Tea, Swazi:*

This experiment comparing tipping heights of 4, 6 and 8 ins. above the pruning cut was pruned and tipped at the beginning of the season. During the tipping and table forming phase, from July to November, significant amounts of crop were lost by the two longer tips over the shorter, there being no significant difference between the two longer. As can be seen from Table VII, these losses were made good during the remainder of the season and there are no significant differences for the total seasonal crop. This conforms with previous experience.

Table VII: Effect of Tipping Height on Yields of India Jat Tea, Swazi

(*in lb. m.t.p.a.*)

Tipping height	4 *ins.*	6 *ins.*	8 *ins.*	*L.S.D.*
Tipping phase, July–November	161	125	111	P0.01=24
Whole season	1,495	1,420	1,460	none

(ii) *Tipping of Local Jat Tea, Thornwood Estate:*

In the Thornwood three cubed factorial experiment only the annual cycle plots were pruned and tipped at 2, 4 and 6 ins.; the remaining two and three-year cycle plots being unpruned and hence untipped. During the tipping and table forming phase there were significant differences, due to tipping height, and there was a significant interaction between tipping height and pruning. These main effect and interaction differences are lost during the remainder of the season and no significant differences remain due to tipping height, as can be seen in Table VIII: There was no significant carry-over effects on yield from the previous season's tipping height for the unpruned tea.

Table VIII: Effect of Tipping on Local Jat Yields, Thornwood Estate

(*in lb. m.t.p.a.*)

	Tipping phase			*Mean*	*Whole season*			*Mean*
	2 *ins.*	4 *ins.*	6 *ins.*	*yield*	2 *ins.*	4 *ins.*	6 *ins.*	*yield*
Annual cycle	117	80	77	92	1,050	1,038	960	1,016
Two-yearly	35	37	34	35	873	771	762	802
Three-yearly	37	36	41	38	822	771	762	838
Mean yield	63	51	51	—	915	883	858	—
L.S.D. mean effect tipping	(0.05)=11			No significant differences for tipping or interaction tip + prune.				
L.S.D. interaction tip + prune	(0.05)=25							

(iii) *Effect of Tipping Height on Wood Formation within the Bush, Thornwood:*

In last season's Report it was stated that bigger wood was formed within the bush when tipping height was increased. Similar observations were made this season with the same result although the picture was more complex as fertilizer rates are also beginning to have a direct effect on wood growth.

Plucking Experiment

(i) *Plucking on* 6, 10 *and* 14 *day Rounds, Swazi:*

This experiment completed its first year from prune and as in previous years plucking standard was sufficiently uniform between treatments as to cause no bias in treatment yields, although there was a tendency to pluck coarser leaf as the length of round increased. A significant amount of crop at P0.05 was lost for each upward step in the length of round.

Table IX: Effect on Yields of increasing the Length of Plucking Round

(*in lb. m.t.p.a.*)

Length of round	6 *day*	10 *day*	14 *day*	*L.S.D. P*0.05
Yield	995 ..	882 ..	778 ..	74

The difference between six and ten day rounds is significant at P0.01 and that between 10 and 14 day rounds fails to reach this level of significance by only 4 lbs. (L.S.D. P0.01=108 lbs.)

Manuring of Tea

Reference has already been made to the effect of an artificial mixture on the establishment of newly planted tea and upon subsequent new growth rates.

All the tea used in the experiments described in this section is spaced 4×4 ft. sq. and the effect of fertilizer in conjunction with different spacings will be dealt with under the section on spacing below.

(i) *Sulphate of Ammonia at Four Rates on Mature Indian Tea, Swazi:*

This experiment in its third and last year from prune compared applications of sulphate of ammonia providing 0, 32, 52 and 70 lbs. of nitrogen per acre. The yields of this experiment were extremely low due to a combination of adverse affects. It occupies an exposed unshaded northerly site, and this, together with the fact that it entered the season carrying a heavy top hamper, aggravated the effects of the seasonal shortage of rain. The experiment suffered extremely bad sun scorch during the drought of 1948/49 whilst it was still recovering from prune and this damage is particularly noticeable on the low fertilizer plots which were poorly protected by sparse new growth. During the last ten years no phosphate or potash have been applied and it is possible that a lack of these nutrients is being felt, although no classical leaf symptoms are showing. The no fertilizer plots yielded only 134 lbs. of made tea per acre and after discussion it was agreed that the treatments should be altered at the onset of the 1954/55 season. The three cubed N.P.K. fertilizer experiment at Swazi will enter its fourth season of treatments in July, 1954, and the necessity for the present experiment will consequently lessen. The no fertilizer plots are in future to receive sufficient sulphate of ammonia to provide 120 lbs. nitrogen per acre in the hope of observing any build-up effects and all plots are to receive a medium dressing of phosphate and potash. Soil analyses are to be made of the present treatment plots to record the effects of continual applications of sulphate of ammonia. The past season's results are recorded in Table X.

Table X: Effect of Nitrogen on Yields of Mature India Tea, Swazi

(*in lb. m.t.p.a.*)

Lbs. nitrogen per acre	0 ..	35 ..	52 ..	70 ..	L.S.D. P0.01
Yield m.t.p.a. ..	134 ..	247 ..	267 ..	337 ..	64

Excluding the unpredictable N52, each upward step in nitrogen has significantly increased crop and the increase is highly linear. From N0 to N35, 3.2 lbs. of made tea were recovered for each lb. of nitrogen added; from N35 to N70. 2.6 lbs. of made tea. Rainfall November to April totalled 51.46 ins. against an average of 60.71 ins.

(ii) *Three cubed Factorial N.P.K. on Mature India Tea, Swazi:*

This experiment completed its third successive year of treatments and the previous two years' results are repeated in that highly reliable increases in crop were obtained from nitrogen dressings applied as sulphate of ammonia whereas no significant differences were caused by superphosphate or muriate of potash.

Table XI: Effect of N.P.K. on Yields at Swazi

(*in lb. m.t.p.a.*)

Treatment	*Nitrogen* (N)			*Phosphate* (P_2O_5)			*Potash* (K_2O)		
Nutrient level lb. p.a.	40	80	120	0	30	60	0	30	60
Yield m.t.p.a.	606	814	1,041	819	803	839	808	849	804
L.S.D.	P0.01 = 90			None			None		

The effects of nitrogen are linear up to the highest rate and for each lb. of nitrogen applied between the two lower rates 5.2 lbs. of made tea were recovered and between the two higher rates 5.7 lbs. made tea.

(iii) *Sulphate of Ammonia on Local Jat Tea, Thornwood Estate:*

In this extension experiment, previously referred to above under the sections on pruning and tipping, three rates of sulphate of ammonia are applied which provide nitrogen equivalents of 40, 80 and 120 lbs. per acre.

Table XII: Effect of Sulphate of Ammonia on Local Jat Tea, Thornwood

(*in lb. m.t.p.a.*)

Nitrogen lb. per acre	40	80	120	L.S.D. P0.01
Yield m.t.p.a.	709	878	1,069	111

A highly reliable increase in crop was obtained for each upward step in nitrogen and there is no falling off in effect right up to the highest rate. The recovery in lb. made tea for each lb. of nitrogen added was 4.23 lbs. between the two lower rates and 4.77 between the two higher.

The pruning treatments were such that this season yields were obtained from newly pruned plots and from plots which were unpruned and in their second year from prune. This has affected response rates to nitrogen as can be seen from Table XIII.

Table XIII

Response to each lb. of Nitrogen added in lb. made Tea

	*From n*40 *to n*80	*From n*120 *to n*120	*Mean*
Newly pruned	2.62	3.73	3.17
Unpruned	5.05	5.30	5.18

A considerable increase in response or recovery rate was obtained with the unpruned tea and this is in agreement with previous work in Ceylon and at Swazi. The slight increase in response between the two higher rates for each stage of pruning is not explicable from experimental evidence but might be due to a more rapid build-up of the bush and consequently making it into a more efficient utilizer of nitrogen. If this is so then these slight differences will be expected to disappear in subsequent years when the treatments have been applied sufficiently long to allow the bush to become stablized to its manurial treatment.

It is of interest to record that when averaged over tipping heights the annual pruned plots, receiving the equivalent of 80 lbs. of nitrogen per acre, yielded for the season 1,001 lbs. made tea per acre, against a yield of 1,029 lbs. m.t.p.a. from unpruned two-yearly plots receiving 120 lbs. of nitrogen.

(iv) *Sulphate of Ammonia at Four Rates on Young Indian Tea, Swazi:*

This experiment continued on tea planted in 1946 and compares the effects of dressings of sulphate of ammonia providing the equivalent of 0, 80, 160 and 240 lbs. nitrogen per acre. Yields for the past season are recorded in Table XIV.

TABLE XIV: EFFECTS OF NITROGEN ON YIELDS OF YOUNG INDIAN JAT TEA, SWAZI
(*in lb. m.t.p.a.*)

Nitrogen level in lbs.	0	80	160	240	L.S.D.
Yield	830	1,049	1,133	1,121	0.05=100; 0.01=138

All rates of fertilizer have significantly increased crop over the unfertilized control but there are no significant differences between the yields of any of the fertilizer rates. A dressing of 80 lbs. of nitrogen for young tea appears, therefore, to be the upper limit and supports previous experience from this experiment that young tea is not able to utilize high amounts of nitrogen. The return in lb. made tea for each lb. of nitrogen added was 2.73 from N0 to N80.

(v) *Nitrogen or Sulphur:*

There were no significant differences in yields caused by nitrogenous fertilizers with or without sulphur. The unfertilized control plot continues to lose ground and there might be significant differences next season.

For effects of sulphur on the growth of newly planted tea, see previous section on establishment experiments and the section on spacing.

TIME OF FERTILIZER APPLICATION

(i) *Four times during the Main Crop Season, Swazi:*

The experiment continued which compares applications of sulphate of ammonia providing the equivalent of 80 lbs. of nitrogen per acre per season either in whole or in split doses. The treatments compared are:

N.	Whole application first week in November.
½N, ½J.	Half application first week in November and remaining half first week in January.
J.	Whole application first week in January.
½N, ½M.	Half application first week in November and remaining half first week in March.

There were no formal significant differences due to treatments though there was a 14 per cent. difference between the highest and the lowest yield. The field layout of this early treatment is demonstrably poor and with the standard of precision obtained differences due to treatments of the order of 25 to 30 per cent. would be required to be significant at P0.05. Yields, as a percentage of the whole November application, are recorded in Table XV and suggest that benefit is to be obtained by applying fertilizer at the start of or early in the main crop season.

TABLE XV: YIELDS FROM FOUR TIMES OF FERTILIZER APPLICATION EXPRESSED AS PERCENTAGES OF THE WHOLE NOVEMBER TREATMENT

	Season				
Time of application	*50/51*	*51/52*	*52/53*	*53/54*	*Mean*
N	100.0	100.0	100.0	100.0	100.0
½N, ½J	90.7	98.5	94.2	99.5	95.7
J.	87.0	95.6	88.7	94.4	91.4
½N, ½M.	88.2	93.0	84.9	85.9	88.0

(ii) *Dry Season against Early Crop Season Dressings, Swazi:*

The experiment referred to above, as comparing 0, 35, 52 and 70 lb. nitrogen per acre as sulphate of ammonia, has split plots to allow a complete application to be made either during the first week in July, at the beginning of the dry season, or during the first week of November at the beginning of the main rains and the crop season. These sub-treatments were first applied in the 1952/53 season and for that season and the present, a highly reliable gain in crop was obtained with the November dressing.

Table XVI: Effect of July and November Fertilizer Dressings on the Yields of Tea as a Percentage of the November Yield

Season	Time of application		L.S.D.
	July	November	P0.01
	per cent.	per cent.	per cent.
1952/53	86.7	100	9.6
1953/54	85.5	100	9.3

No reason can be given for the drop in crop caused by the July dressing.

From the results of these two experiments it would appear that of the times of application so far examined the best results will be obtained by a November application.

Spacing of Tea

(i) *Four Spacings, Swazi:*

No significant differences in yield were obtained in this experiment and there is no reason to alter the conclusions given in last year's Report.

(ii) *Sulphur Deficiency:*

Two experiments, compare in factorial layouts various spacings of tea and variousr rates of nitrogen as sulphate of ammonia. The original plan was to increase fertilized rates year by year until the full rate was reached at eight years after planting and these increasing rates were evolved from experience gained with the young tea at Swazi experiment, described above, and which received straight sulphate of ammonia after it was four years old. Unfortunately in these new factorial experiments the sulphate of ammonia rates per bush were too low in some of the spacing × fertilizer combinations and " yellows " developed suddenly with the onset of the dry weather. Sulphur was therefore in some cases deficient and the effects of nitrogen might be limited or at best confused by this deficiency. In similarly aged and adjacent non-experimental tea, planted at 4 × 4 ft. sq. and receiving the same low rates of sulphate of ammonia but with superphosphate and muriate of potash added, no sulphur deficiency showed and this must be due to the extra sulphur provided by the superphosphate.

Although straight forward effects for the first year cannot be relied upon for the lower rates, the situation had a saving grace in that valuable information was gained as to the minimum sulphur rates required and these are listed below. In subsequent fertilizer dressings to these experiments and in all new experiments, the quantity of sulphur supplied by the fertilizer combination will be augmented by flowers of sulphur, sufficient to bring the total sulphur up to highest rate in any treatment combination and this is designed to be at least sufficient to ward off " yellows." Sulphur, it is hoped, will not thereby be a limiting factor as it was this year.

In all treatments combinations, whereby a single bush received less than 0.07 ozs. of sulphur, or 0.33 ozs. sulphate of ammonia, sulphur deficiency was noted.

These remarks apply to newly planted tea. No " yellows " show in mature tea at Swazi, which has received no fertilizer in any form for eight years. This age effect is probably due to a more mature root system emploring more soil. There is no reason to suspect major soil differences between Swazi and Mimosa.

Table XVII: Minimum Sulphur Requrements for newly planted Tea based upon Experience during 1953/54

Spacing	Lbs. per acre for first year tea Minimum sulphur requirement in
4 × 4 square	17
4 × 3 rectangular	25
4 × (2½ × 2½) hedge	30
4 × (2 × 2) hedge	45

Tea in its second year from planting requires double these minimum rates.

(iii) *Spacings and Sulphate of Ammonia, Mimosa:*

Two experiments at Mimosa compare factorial combinations of spacings and fertilizer rates. At first prune, the weights of prunings by plots were taken and although the occurence of sulphur deficiency in some of the combinations lessens the reliability of the information obtained, from the lowest rate of nitrogen, the results are interesting and are summarized below.

Increasing the number of plants per acre, proportionately and directly, increased the total weight of prunings taken per acre, although the reverse was true for mean bush yield. The loss in bush yield is therefore more than offset by the increased number of bushes per acre.

Averaged overall spacings, and judged on a per bush weight, little benefit was obtained from dressings of more than 0.68 ozs. of sulphate of ammonia per plant. This equals about 20 lbs. of nitrogen per acre for 4×4 ft. square spacing and might be on the high side. There was no significant interaction between spacing and fertilizer and consequently a guide to sulphate of ammonia rates for first-year tea can be calculated from the figure quoted above.

Tea planted at 4×4 ft. square	116 lbs. p.a. S./A.
Tea planted at 4×3 ft. rectangular	154 lbs. p.a. S./A.
Tea planted at $5 \times (2\frac{1}{2} \times 2\frac{1}{2})$ hedge	197 lbs. p.a. S./A.
Tea planted at $4 \times (2 \times 2)$ hedge	308 lbs. p.a. S./A.

A further replication of one of these experiments was planted this season and has received flowers of sulphur together with its sulphate of ammonia. More reliable information on sulphate of ammonia rates should therefore be available by next year.

Weeds and Weeding

(i) *Effects of Weeds and Grasses on the Yield of Tea, Swazi:*

This experiment, comparing the effects of weeds and grasses on the yields of tea, gave no significant differences in yield due to treatments which were as in last year's Report.

The general conclusions to be drawn from this unprecise experiment bear out experience in other countries, that where tea can be encouraged to provide a full soil cover, then weed growth is not sufficient to interfere greatly with yields. In short the tea bush itself is the best "hoe for weeding."

(ii) *Effects of Fertilizer on weed growth under mature tea, Swazi:*

The three cubed factorial N.P.K. at Swazi has been used to give information on weed growth under mature tea, in relationship to fertilizers. For two successive years the plots were left unweeded during the wet season months of November, December and January and an attempt was then made to cut off at soil level all weed growth, which was weighed separately by plots. This is a crude and very slow method and the experimental precision attained is low. Nevertheless the data collected is of interest and is summarized in Table XVIII.

Table XVIII: Effect of Fertilizers on Total Weed Growth in Lb., Swazi Three-cubed N.P.K.

Nutrient	*Nitrogen* (N)			*Phosphate* (P_2O_5)			*Potash* (K_2O)		
p.a.	40	80	120	0	30	60	0	30	60
Newly pruned	1,381	1,568	1,612	1,191	1,546	1,824	1,586	1,225	1,750
Second year from prune ..	774	626	562	677	568	717	641	557	764

This experiment consists of two complete replications, one of which is pruned a year before the other. The data is thus collected over two successive seasons for newly pruned tea and refers to the totals from both replications, whereas the data for the second year from prune refers to only half of the experiment and has not been formally analysed, pending the results from the second replication which will be taken this season. Comparison should therefore be made between the actual weights between time from prune.

Under newly pruned tea, with a relatively sparse foliage and soil cover, increased nitrogen dressings have caused an increase in weed growth but less from N80 to 120 from N40 to 80. The difficulties are not significant at P0.05. Increasing phosphate dressings have caused a much greater increase in weed growth and the differences between the highest and the lowest rates are significant at P0.05. Potash has had a peculiar effect on weed growth in that a medium dressing of 30 lbs. of potash has decreased weed growth but not significantly so. These results parallel similar data recorded by Eden for Ceylon, even to the depressing effect of a medium potash dressing.

For the half of the experiment, which was this season in its second year from prune, increasing nitrogen rates have turned about in their effects and depressed weed growth. This is most likely due to increased dressings, increasing the rate and density of the new growth in the top hamper thereby causing a more efficient soil cover which in proportion depresses weed growth.

No comment is offered on the effects of phosphate, until it is seen whether or not the depression of weed growth by the middle rate is maintained by the remaining half of the experiment, which will be two years from prune this coming season. The middle rate of potash has again depressed weed growth.

Weighing of weeds will be continued throughout a complete three-year cycle for both replications.

Permanent Shading of Mature Tea

(i) *Observation plots, Swazi:*

Records continue to be taken from observation plots shaded with *Albizzia glabrescens* and from immediately adjacent unshaded tea similar in jat, age and cultural treatment to the former. Half of each plot receives no fertilizer and the remaining half, sufficient sulphate of ammonia to supply the equivalent of 80 lbs. of nitrogen per acre. Yields in lb. made tea per acre are recorded in Table XIX.

Table XIX. Effect on Yields of Shade with and without Nitrogen, Swazi

(*in lbs. m.t.p.a.*)

	Without shade	*With shade*	*Mean for nitrogen*
Without nitrogen	362	663	513
With nitrogen	681	756	719
Mean for shade	522	710	—

For the fifth year in succession shade has increased yield over no shade. Nitrogen has increased yields but proportionately much less under shade than under no shade. Under no shade each lb. of nitrogen has returned 4.0 lb. of made tea whereas under shade the return has only been 1.2 lbs. Shaded tea without nitrogen has yielded nearly as much as the unshaded plots receiving 80 lbs. of nitrogen. This parallels experience in Assam.

(ii) *Shade Trees and Fertilizers, Mimosa:*

This statistically designed experiment was pruned for the second time this season and there were no significant differences in pruning weights. In common with estate experience in Nyasaland and especially with Mlanje experience, young *Grevillea* trees were more prone to white ant attack than either *Albizzia* or *Glyricidia*. All shade trees vacancies were supplied during the early part of the rains and the end of the season very few blanks remained. The tea was lightly plucked and yields are recorded in Table XX. At that stage no differential fertilizers are applied to the sub-plots.

Table XX. Effect on Yields of Shade Trees at Mimosa

(*in lbs. m.t.p.a.*)

Shade	*None*	*Glyricidia*	*Grevillea*	*Albizzia*	*L.S.D.*
Yield	90	96	112	110	P0.05=7

Tea under *Albizzia* and *Grevillea* has out-yielded unshaded tea or tea shaded by *Glyricidia*. This it must be admitted is rather a surprising result, considering that the oldest shade trees were only 18 months old at the end of the season. The differences are shown as significant at the 5 per cent. probability but in fact they are significant nearer to a per cent. probability. Nevertheless, it is doubted that the differences are due to treatment effects as such, because of the three species of shade only *Glyricidia* has made sufficient growth to offer any shade or wind-break effect. The remaining two are as yet upright, unbranched, thin saplings, offering very little over head shade or wind-break protection, and it is to be questioned if they can have had a real effect on yields.

At each of the two prunes no significant differences were found for pruning weights and it would be expected that similar non-significant differences would be reflected in yields (there are only small differences in the standard error percentages between pruning yields and tea yields for this season). Very high and significant correlation coefficients have usually been found between yields and pruning weights. The tea at the end of the season was two and a half years old.

Miscellaneous

It becomes increasingly apparent that major fluctuations in yield and response to cultural treatments are dependent upon fluctuations of climate which are very wide. Under these circumstances it is difficult to understand the separate effects of major cultural treatments or combinations of these effects. Seasonal yield has not been found to be closely correlated with total seasonal rainfall and thus a detailed examination of climatic factors and their effects on crop has been started but few positive results have been obtained.

During these investigations rainfall maps were drawn of the tea areas and confidence limits for seasonal and monthly totals calculated. The net result of this work leads to the conclusion that rainfall (climate) is so variable that any use of an average or a total must be a matter of practical convenience and not one of accurate or near accurate description of the climatic period under discussion. Using monthly total rainfall, there is only small and unreliable correlation between one month and the next; prediction cannot therefore be made for the general level of rainfall from one month to the next.

Based on monthly units of climatic factors and crop, average crop was found to be linearly related to the square root of average rainfall but no advantage was gained from this knowledge, because the deviation around the mean is so large that the benefit to be obtained from using the square root of rain leads only to minor improvements in the correlation coefficients. Average monthly crop was found to be exponentially related to mean monthly maximum temperature, as measured in a Stevenson screen and has a maximum value at 83.2°F. The linear relationship being between log crop and the square of the temperature difference in degrees from 83.2°F. This again led to no improvement because of large deviation around the mean. An attempt was made to investigate the existence, if any, and the type of interaction between rainfall, maximum temperature and crop, but failed because of missing yields at essential points in the climatic values. It is to be doubted that any advantage would be obtained because mean monthly rainfall is closely and reliably correlated to mean maximum by an exponential (but probably slightly skew) relationship similar in type to the crop maximum relationship and in essentials mean maximum temperature is merely another measure of rainfall totals.

Mean monthly minimum temperature is poorly related to crop and mean relative humidity at 2 p.m. in a Stevenson screen is related to crop by a lag-log-decline type of curve.

Attempts to classify monthly rainfall efficiency, by considering the distribution and size of showers within the month, have not produced any worthwhile results as yet.

(ii) The investigation into malgrowth on one estate, referred to in last year's Report, was completed and no pathological or entomological organism was found to account for the trouble, which is now considered to be primarily due to normal cultural methods being inadequate for the tea which grows on a peculiar soil type and under localized but extremes of climatic conditions. The analytical data has been published elsewhere.

Pests and Diseases

Diseases:

Very few reports of disease have been received during the year, and in practically every case, the ever-present *Armillaria mellea* has been identified as the casual organism. The fact that this disease is being reported less frequently from young plantings leads one to hope; that the control measures laid down years ago by R. Leach, are now being observed much more strictly.

The "Violet Root Rot" (*Helicobasidium compactum*) is still active in some nurseries, and one or two severe outbreaks of Brown Blight (*Colletotrichum camelliae*) have occurred mainly in nurseries.

Pests:

The most troublesome pest in both tea districts is undoubtedly the termite, and plans are in hand to test the effectiveness of some of the newer insecticides (Aldrin, Dieldrin, Chloridane, etc.) in the coming planting season.

Other pests recorded during the season were:—

Helopeltis bergrothi (Mosquito Bug). Incidence this season has been less than last season, but the bug requires careful watching especially during March/July.

Physothrips setiventris (Thrips): Most common in the Cholo District.

Both of these pests are fairly readily controlled by D.D.T., and the use of "fogging" techniques, which promise cheaper and easier results, are being studied.

Metatetrancychus bioculatus (Red Spider): There are early indications that this mite will be fairly widespread on "local" tea during September and October. Preliminary tests of a new miticide are planned.

Argyroploce leucotreta (False Codling Moth): One case of tea seed being bored by the larvae of this moth was confirmed. Although this pest has been reported as causing similar damage to tea seed in East Africa, this is the first positive record for Nyasaland.

Tachardia actinella (Scale): This purple staining scale was found on one tea bush at Mimosa. The bush was suffering from "Tea Yellows," and no spread of the scale to adjacent vigorous bushes was observed.

Aspidiotus Sylvaticus (Scale): Found infesting a nursery of *Albizzia Procera*. Previously recorded on tea in Mlanje in 1936.

Oxyrachis tarandus: A black, horned, hopper, present in large numbers on *Albizzia gummifera*. May be responsible for the "brooming" effect on young branches and foliage.